

1944

Statistical Methods for Accountants.

Leo Herbert

Louisiana State University and Agricultural & Mechanical College

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_disstheses



Part of the [Accounting Commons](#)

Recommended Citation

Herbert, Leo, "Statistical Methods for Accountants." (1944). *LSU Historical Dissertations and Theses*. 7882.
https://digitalcommons.lsu.edu/gradschool_disstheses/7882

This Dissertation is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Historical Dissertations and Theses by an authorized administrator of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.

STATISTICAL METHODS

FOR

ACCOUNTANTS

A Thesis

**Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy**

in

The Department of Business Administration

by

Leo Herbert

B.S., Brigham Young University, 1939

M.B.A., Louisiana State University, 1941

June, 1944

UMI Number: DP69260

All rights reserved

INFORMATION TO ALL USERS

The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if material had to be removed, a note will indicate the deletion.



UMI DP69260

Published by ProQuest LLC (2015). Copyright in the Dissertation held by the Author.

Microform Edition © ProQuest LLC.

All rights reserved. This work is protected against
unauthorized copying under Title 17, United States Code



ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

Q5742
6

ACKNOWLEDGMENTS

The writer wishes to express his sincere appreciation to Professors E. A. Saliers, S. W. Preston, and P. F. Boyer for the helpful cooperation they offered and the invaluable suggestions for the improvement of the content and construction of the dissertation. Professor Saliers, under whose guidance the work was completed, made many constructive comments pertaining to the general outline and the readability of the work. Professors Preston and Boyer made many invaluable suggestions for improving the ideas and content and due appreciation of their many hours of diligent help is accorded.

The writer is indebted to each of these men and the other members of the thesis committee, Dean J. B. Trant, Professor H. L. McCracken, and Professor S. A. Caldwell for the guidance given to him both in the classroom and as members of the committee, and for instilling in him the desire to continue in the search for knowledge.

378.76
L9302
101111

TABLE OF CONTENTS

Chapter	Page
I. ACCOUNTING AND STATISTICS.....	1
Introduction.....	1
Statement and Limitations of the Problem.....	4
Definition of Accounting and Statistics.....	4
History of Accounting and Statistics.....	7
Relation between Accounting and Statistics.....	11
Limitations of Statistical Methods.....	13
II. GENERAL ACCOUNTING STATISTICAL METHODS.....	15
Classification of Accounts.....	15
Purpose of Classification.....	15
Fundamentals of Account Classification.....	16
Account Titles and Symbols.....	18
Account Arrangement.....	19
Account Symbols.....	22
Illustration of Classification and Symbols.....	24
Statistical Classification.....	29
III. GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED.....	32
Percentages and Ratios.....	32
Percentages.....	33
Methods of Computing Percentages.....	33
Application of Percentages and Ratios to	
Accounting Problems.....	37
Discounts.....	37
Use of Percentages and Ratios in Partnership Accounting.	38
Use of Percentages and Ratios in Estimating Depreciation.	40
The Retail Method of Inventory.....	42
Miscellaneous Accounting Uses of Ratios and Percentages.	47
IV. GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED.....	49
Ratio Analysis of Single Financial Statements.....	49
Ratio and Percentage Analysis in General.....	49
Balance Sheet Analysis.....	52
Analysis of Items on the Profit and Loss Statement.....	64
Analysis of Items on Both the Balance Sheet and	
Profit and Loss Statement.....	69
Miscellaneous Ratio and Percentage Analysis.....	74

V. GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED.....	80
Averages and Dispersion.....	80
Meaning and Characteristics of Averages.....	80
Arithmetic Mean.....	82
The Median.....	88
The Mode.....	90
The Harmonic Mean.....	92
Geometric Mean.....	94
Accounting Uses of Averages.....	94
Dispersion.....	99
VI. GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED.....	104
TIME SERIES.....	104
Trends.....	104
Trend Percentages.....	105
Secular Trend.....	107
Profit Trends.....	114
The Statement of Application of Funds.....	115
Seasonal Variations.....	122
Measurement of Seasonal Variation.....	123
Accounting Uses of Seasonal Indexes.....	129
Cyclical Variation and Forecasting.....	131
Normal in Business Statistics.....	132
Uses of Cyclical Indexes.....	133
VII. GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED	
INDEX NUMBERS--CORRELATION.....	139
Index Number.....	139
Index Number Construction.....	140
Table of Most Common Business Indexes.....	147
Correlation Analysis.....	149
VIII. GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED	
STATISTICAL PRESENTATION OF ACCOUNTING DATA.....	153
Tables.....	153
Charts.....	156
Bar Charts.....	158
Line Charts.....	163
Area Charts.....	171
IX. STATISTICAL METHODS FOR THE PUBLIC ACCOUNTANT.....	172
Sampling or Test Checking.....	176
Application of Sampling Technique by Auditors.....	184
X. STATISTICAL METHODS FOR PUBLIC ACCOUNTANTS, CONTINUED.....	187
Statistical Presentation of Accounting Data.....	187
New Type Accounting Statements.....	187
Tabular Presentation.....	207
Charts.....	210

XI. STATISTICAL METHODS FOR COST ACCOUNTANTS.....	211
Cost Accounting and General Accounting.....	211
Types of Cost Systems.....	213
Job Order Cost Accounting.....	215
Inventory Accounting.....	215
Raw Material Control.....	215
Goods in Process Inventories.....	226
Finished Goods Inventories.....	227
Labor Control and Accounting.....	228
Social Security and Income Tax Accounting.....	234
Overhead Accounting.....	236
XII. STATISTICAL METHODS FOR COST ACCOUNTANTS, CONTINUED.....	247
Process Costs.....	247
Process Costs--Illustration One:.....	249
Process Costs--Illustration Two:.....	250
XIII. STATISTICAL METHODS FOR COST ACCOUNTANTS, CONTINUED.....	263
Standard Costs.....	263
Material Standards.....	265
Labor Standards.....	266
Standards for Overhead.....	266
Variation Analysis.....	267
Estimating Cost Accounting.....	273
Distribution Costs.....	274
Break-even Points.....	277
Differential Costs.....	282
Cost Statements and Reports.....	284
XIV. MISCELLANEOUS USES OF STATISTICAL METHODS BY ACCOUNTANTS.	287
Uniform Cost Accounting.....	287
The Development of Uniform Accounting.....	287
The Principles of Uniform Accounting Systems.....	289
Statistical Uses of Trade Association Accounting.....	290
Index Number Accounting.....	294
SELECTED BIBLIOGRAPHY.....	296

ABSTRACT

The common meaning of statistical methods refers to the methods used in handling quantitative data. The problem of this dissertation is to determine what statistical methods are employed in the analysis of accounting data. The general outline is as follows:

- I. Introduction and History of Accounting and Statistics.
- II. Statistical Methods for General Accountants.
- III. Statistical Methods for Public Accountants.
- IV. Statistical Methods for Cost Accountants.
- V. Miscellaneous Statistical and Accounting Methods.

A brief statement of the problem and a limited discussion of the relation of accounting to statistics is developed in the first chapter. The historical background of each field is also discussed.

Seven chapters are devoted to the special types of statistical methods which are helpful to the general accountant in the analysis of accounting data. Basic procedures involved in classification for accounting and statistical methods are described so that accounting data may be properly classified for further analysis.

Percentages and ratios are described and illustrations of applications of percentages and ratios, such as discounts, partnership analysis, depreciation, retail method of inventory, dividends, interest, income tax, and sales tax, are explained. Ratio analysis of single financial statements is considered, all of the useful ratios

pertaining to the balance sheet, the profit and loss statement, and the manufacturing statement being explained. Relationships between items on the balance sheet, between items on the profit and loss statement, and between items one of which is on the balance sheet and the other on the profit and loss statement are summarized.

A description is given of the various methods of computing the commonly used averages: the arithmetic mean, the median, the mode, the harmonic mean, and the geometric mean. The uses of the various averages in connection with various accounting data are then explained. Averaging depreciation rates, inventory values, sales, production, earnings, wage rates, partnership capital balances for profit distribution and accounts for payment are explained as the application of averages. Measures of dispersion, such as the standard deviation, the average deviation, and the quartile deviation are explained in conjunction with the various averages.

Movements in time series are next introduced. Trends, seasonal variations, and cyclical variations are explained. The discussion of trend movements deals with trend percentages, secular trend, profit trends, and the statement of application of funds. Various methods of computing seasonal variation and the accounting uses of seasonal indexes such as estimating inventory requirements, sales, production, employees, and advertising are explained. The computation of cyclical indexes and the procedures for forecasting from the indexes are described.

Methods of calculating index numbers are explained and a list of the commonly used business indexes is given. Simple correlation methods--the regression equation, the standard error of estimate, and the coefficient of correlation--are discussed for possible uses in the analysis of accounting data.

In the last chapter in the section on statistical methods for general accountants are considered the various methods of presenting accounting data, exclusive of the formal accounting statements.

In the description of statistical methods for public accountants, two separate items not previously mentioned in the section on statistical methods for general accountants are described. One chapter deals with sampling theory and the sampling techniques as applied to auditing. General rules are listed which apply to "test-checking" or sampling of items in an audit which show results from which conclusions may be drawn as to the accuracy of the accounting records being audited without having to analyze every transaction.

Presentation, in non-technical and descriptive language, of accounting data in new type accounting statements for the use of employees, stockholders, and the general public is illustrated by the use of published statements.

The section on statistical methods for cost accountants deals with the application of previously explained statistical methods to cost accounting data. Statistical methods applicable to cost accounting data are described under three major headings: job-order cost accounting, process cost accounting, and standard cost accounting.

Methods of material control and methods of valuing inventories are examined. Labor control and wage payment plans are described. Calculations necessary to compute income and social security taxes on the employee and social security and unemployment taxes on the employer are considered.

Ways of distributing service department expenses to the overhead expenses of productive departments are described. The application of overhead to jobs is discussed and the relative merits of each method of distributing overhead, such as direct labor cost, direct labor hours, machine hours, and units produced, are examined to determine the most satisfactory employment of each method.

Process cost accounting is used in industries employing continuous production or mass production methods. In process costs, statistical methods are used in the determination of unit costs, inventory values, and equivalent production. Methods of determining unit costs, inventory values, and equivalent production are described for various situations such as a company having numerous departments; uneven application of material, labor, and overhead; and loss or gain in units during the productive process.

In standard cost accounting, a standard cost is determined for the materials, labor, and the overhead. At the end of the accounting period, variations between the standard cost of these items and the actual cost are determined. Methods for setting material standards, labor standards, and overhead standards are described. The analysis

of variations in prices and quantity between the actual cost and the standard cost for material, labor, and overhead is developed. In connection with overhead analysis, methods of determining variations from standard, regardless of the capacity of operation of the plant, are described.

Two other types of cost accounting systems, viz., estimating cost and distribution costs, are described. Differential costs, break-even points, and proper presentation of cost data for management is introduced.

The last chapter describes two miscellaneous uses of statistical methods in accounting, viz., applications of uniform cost accounting systems and "index-number accounting."

CHAPTER I

ACCOUNTING AND STATISTICS

Introduction

Accounting has become a standardized word in the vocabulary of all business men. More and more one hears of the statistics of business, and the two words, accounting and statistics, are becoming more closely associated. Often it has been necessary for a firm to make a new division in its organization--the "Statistical Division." The trend at the present time, however, is to incorporate this division under the office of a "Comptroller" or some similar title and to expand the accounting field so that more than just bookkeeping or auditing is carried on in the accounting department. Thus under a modern organization, from one department it is possible to furnish the management, the stockholders, and other interested parties information regarding the accounts, the financial condition, management controls, budgets, operation reports, trends, and other related data which may be used in achieving a more successful operation of the business.

Facts, upon which any successful business must rely, are gathered, analyzed, and reported to the proper places, so that reliable judgments may be made regarding business conditions and operations.

There is a definite reason for the increased use of statistical methods in accounting and business. Increasing size of the business unit demands some factual method of keeping records of operations rather than subjective estimates which at best are only guesses as to conditions of business. As corporations increase in size, much of the record keeping has to be done in units as well as in amounts. Payroll summaries, which are often prepared hundreds of miles from the home office, must check with hours worked and the amount paid. The largest share of this detailed work is absorbed by the accounting department so that payroll accounting becomes one of the important functions of the department. Raw materials, goods in process, and finished goods are the equivalent of cash and, to be consistent, some method of providing information regarding inventories is as important as regulating cash income and expenditures. In small businesses it is often easy to ascertain whether some of the merchandise has been illegitimately removed, but in large businesses, where division of responsibility prevails, shortages might easily develop and go undetected unless some form of internal checking system was devised. To overcome this obstacle, material accounting is developing with all of its ramifications.

Meanwhile, the regular financial accounting functions continue to expand, so that instead of a bookkeeper and a cash register, separate departments, such as the cashier's office, are introduced, the functions of this office being entirely dealings in cash.

Increased legislation demands that some type of record keeping

be employed to supply the facts desired in the reports and statements which the government requires. This legislation means an increased coordination between accounting and statistical methods. Income tax legislation paves the way for record keeping based on sound accounting principles, which immediately show the income for the year, whether cash or accrual methods are used. Income determination becomes more a matter of scientific reasoning and fact-gathering than of opinions or judgments.

Social security and unemployment legislation tends to demand that more accurate records of time and wages of employees be kept by the accounting department. Income tax payments and deductions at the source tend to do likewise.

Laws such as the Robinson-Patman Act and the State Unfair Practices Act tend to prohibit differentials in price which restrain interstate commerce and which can not be justified by actual differences in cost of serving each customer. A method of proving actual differences in cost is necessary in some instances and supplying the information to prove these differences fell upon the accounting department.

In addition competitive conditions make it necessary for a firm to have facts about costs, sales, prices, and production to be able to stand up under the strain imposed by other individual businesses which do have this information. Cost accounting with its procedures for determining values results in improved methods of arriving at cost figures. Standard costs help to solve problems of variation in

actual prices and quantities from an arbitrarily set up standard for prices and quantities, and results in better management and efficiency.

Statement and Limitations of the Problem

The problem of this paper may be stated in the form of two questions. What statistical methods are employed in the various fields of accounting? May these statistical methods be arranged in such form that an accountant could profitably use them in his work?

Much has been written on statistical methods in business. Some of these methods deal with data completely foreign to the accounting department. Only those statistical devices will be examined which can be employed by the accountant from records at his disposal, which are usually the internal records of a business.

No attempt will be made to explain fully the procedures of computing the simpler forms of statistical methods. Only the methods necessary to explain how accounting processes are statistical and vice versa will be examined in detail.

Definition of Accounting and Statistics

Accounting usually includes all of the gathering, classification, summarization, and interpretation of numerical data of a business or governmental unit. At the present time it also includes financial record keeping of the individual.

The major work of accounting is recording and interpretation of financial data; however, the last hundred years has shown a trend away from mere financial data and at the present time recording and

analyzing production units, sales units, and labor hours are as important a part of the accountant's duties as dealing with monetary figures. Instead of measuring cash income only, advanced techniques have been developed so as to arrive at a more accurate income figure. For example, depreciation, bad debts, deferred charges, and deferred income have all become common portions of any accounting system.

While statistics is employed a great deal in the analysis of economic and business data, that is not where it originally developed. As the name suggests, statistics came from dealings with the state. However, the purpose at the time the name was developed was not to analyze numerically resources of the state. Statistics was pure political science, and not until a century later did the word meaning "statesman's art" take on a special significance of the study of the numerical facts of the state. The relationship of statistics to numerical facts occurred in the latter part of the seventeenth and early part of the eighteenth century.¹

Statistics at the present time has no universally accepted definition. There are two chief representations, however, which are associated with statistics, both of which are numerical. The first use of the word deals with numerical counting or numerical presentation of information, and often one encounters the use of the word in this form in columns of the newspaper where births and deaths are recorded. Thus it can be seen from this definition that

¹Walter F. Willcox, "History of Statistics," Encyclopedia of the Social Sciences, The Macmillan Company, 1937, pp. 356-372.

anything that can be counted or measured would come under the term "statistics." To differentiate the above definition from the more common use of the word, many authors suggest that some appropriate title such as "statistical figures" or "statistical data" be used in place of the one word "statistics," to describe only quantitative data.

Statistics is also used to refer to the methods used in handling quantitative data. Analysis of numerical data is the most common usage of the term and the one employed in this report. "Statistical Methods" sometimes is used as a more descriptive term when referring to the methods of handling quantitative data.

When dealing with methods of quantitative analysis, two basic procedures are employed²: (1) to find a measure which describes a particular series and is considered representative of the entire series. Such typical figures are derived by using the mean, the median, the mode, or index numbers; (2) to find a sample measurement which represents the universe from which the sample is drawn. A limited number of observations is taken, and from this limited number a conclusion is drawn which pertains to all of the observations which may have come under the group. This method is used in conjunction with the first method as it is sometimes impossible to obtain a complete number of observations.

²Albert K. Murts and Harold A. Wigerton, Statistical Dictionary of Terms and Symbols, John Wiley and Sons, Inc., New York, 1939, p. 167.

As it is virtually impossible to separate many of the fine distinctions between accounting and statistics, no attempt will be made to divide the two fields according to common usage. In this report, however, accounting is considered to be the recording of financial data in the double-entry method and the summarization of the data directly from the accounting records. Statistics, moreover, means the analysis of numerical data with which the accountant directly or indirectly deals, whether the analysis takes place before recording, during the recording process, or after the primary accounting statements have been made.

History of Accounting and Statistics

While accounting and statistical methods are at the present time used together a great deal, they originated from different sources and fields. Both were used thousands of years before any definite name was given to each, but it has been only since the extensive development of trade and commerce that logical methods for using either accounting or statistics have developed into any definite pattern.

Some type of accounting is as old as mankind. As long as a person owned anything of value, he had to keep some type of record of that value. It may have been in his head or it may have been written in stone walls of caves, or on papyrus rolls, but some knowledge of the value which the person held was necessary. However, this method of record keeping was not what is commonly known as accounting, as no method was available to prove existence of values

unless actual count was made of the values themselves.

It can easily be seen that accounting would not develop until some method of recording values in a common denominator was developed. Money overcame this difficulty.

Until a person had more than himself to maintain, and others to work for him, it was not necessary to keep too detailed a record of what he owned, providing he was able to exist. When commerce and trade developed, along with an arithmetical device for calculating the effects of that commerce and trade on the individual, a method was developed for recording and analyzing transactions into their component parts. This originated from the idea that every transaction had two or more parts, i.e. for everything of value received, payment of some other value was necessary, or ownership rights or creditor's rights increased also; for everything of value taken out of the business, some other asset increased, some other liability decreased or the ownership equity decreased. By combining these principles, the double-entry method of accounting was developed.

Double-entry accounting, in principle, has remained almost the same for nearly five hundred years since its discovery. However, instead of being just a logical means of keeping records of the financial transactions of a business, it has developed so that the administrative use of accounts is more important than mere record keeping.

Since the development of double-entry accounting, improvements have been made in the refinements of the process itself rather than any attempt to develop a new method of recording values. Instead of

statements being made at the conclusion of the business venture, the pattern today and the trend since the origin of big business is immediate reports and statements. Seldom, if ever, does any business go beyond a year's time before a statement is made and usually monthly statements are demanded. In some businesses such as banking, it is not uncommon to have daily balance sheets, and recently it has been suggested that hourly records be kept for bank analysis. Is it not possible to see that this fund of numerical data would sooner or later be analyzed for the wealth of information which it contains for the business?

Within the last few generations, cost accounting, auditing, and the development of specialized accounting systems have been as important a part of accounting as financial record keeping. Much of the development of statistical analysis has arrived in these fields.

Statistics, much like accounting, developed slowly but surely. Although the development of a process of scientific method finally evolved, originally statistics meant "statesman's art". At first the term was used to differentiate between applied political science and the history and philosophy of politics. There were no numerical relationships expressed and the figures mentioned were seldom and trivial. Almost three centuries passed after the first use of double-entry accounting before the modern idea originated of associating statistics with numerical facts. This does not mean that states or cities did not enumerate their inhabitants and resources for civil or military purposes, but rather that the name "statistics" did not come to mean the results of this enumeration until the eighteenth century.

In the nineteenth and twentieth centuries statistics developed rapidly as a scientific method. Many statistical organizations were formed, and the inductive method became an important part of scientific reasoning. Now statistics is used as one of the methods of arriving at truth in any science where it is not possible to secure absolute accuracy in every measurement. All of the social sciences and many of the physical sciences use statistical methods as a means of arriving at tendencies or relationships which exist, when they are not mechanical or perfect cause and effect relationships.

Frederick Mills makes the following statement regarding the use of statistical data:

Nature is so organized and human faculties are so circumscribed that complete knowledge of the historical or descriptive type is impossible. We cannot discriminate or handle scientifically the multitude of unique objects and events which make up the universe of facts in any given field. We must deal with phenomena in the aggregate, sacrificing detailed knowledge of individual things and events for the wider, more useful, though less precise knowledge of averages. Knowledge of single events, moreover, is of little practical use because of variation in nature, because individual phenomena, even of the same type, are not identical. This is particularly true in the realm of economics. Here not only is it impossible to secure comprehensive and exhaustive knowledge of individual events, but such events have significance for us only when considered in the mass. We would have no use for knowledge of the multitude of individual events, even were such knowledge to be had.

From this view, the generalizations which we term laws are not to be accepted as statements of invariant mechanical relationships, but as statements of tendencies of average relations. In fields where the degree of variation is slight, the conception of perfect mechanical relationship--cause and effect linked by invariant ties--approximates the truth, but material error is involved in the strict application of this

mechanical concept in fields characterized by wide variation and a multiplicity of causes. This is the situation in the field of economics. Hence even the most exact of the laws of economics must be interpreted in this statistical sense.³

Relation between Accounting and Statistics

The relationship between accounting and statistics is a fairly new subject and very few detailed articles have been written on it. However, of all of those who have touched upon this subject, the majority are in agreement as to what accounting is and what statistics is. The disagreement seems to be in the intermediate zone where statistics and accounting are used hand-in-hand, as to what is statistics and what is accounting.

As statistics means the analysis of numerical data, it could easily be taken that the whole field of accounting is statistics. However, as the accounting field is much older and has been separate and distinct, no one seems to want to bring the accounting field definitely under statistics. Such items as recording financial data, auditing, balance sheets and profit and loss statements are as statistical as recording births and deaths, but statisticians have not attempted to consider this part statistical. However, since the turn of the century, since units as well as amounts have become a part of the accounting records, since management has begun to take on the aspects of a science, can it be said that statistics

³Berford Guy Tugwell, Editor, Frederick Cecil Mills, Author, "On Measurement in Economics," The Trend of Economics, Alfred A. Knopf, New York, 1924, pp. 66-7.

and accounting have become one. Statistics is a much broader field than accounting and while many statistical methods have been adopted by the business unit and the accounting department, many other uses which have been developed in specific fields have not been employed to any extent in the business field. Mathematical statistics, for example, is interested in the development of mathematical formulas for use by any of the various fields of statistics.

So, while it may be said that accounting is the field that deals with the classification, recording, summarizing, and analysis of the business records of a firm, many of the methods used in doing this work are now in the statistical field. Any knowledge of statistics that will make accounting better able to guide those for whom the information is intended will probably improve considerably the quality of the work of those who put out that information.

However, to try to reconcile the two fields into definite categories is something which has not yet been accomplished. A summary of definite limitations of subject matter in each field seems impossible. Mr. Seymour L. Andrew of the American Telephone and Telegraph Company sums this up in the following treatise:

"Accounts and statistics"--what do we mean by statistics when we use the term in this association. In presenting briefly my views in answer to this question, I shall not attempt to draw any fine line of demarcation between the field of accounting and the field of statistics in business enterprises. No useful purpose would be served by endeavoring to define the distinction between the two; and besides, it can't be done, at least with any degree of satisfaction either to accountants or to statisticians. For purposes of the present narrative, I shall arbitrarily dispose of the question of whether accounting is a branch of statistics or statistics

is a branch of accounting by agreeing, with minor mental reservations perhaps, with the conclusion of an experienced and practical accountant that in the modern accounting department "statistical work begins at the same point that accounting work begins, and accounting and statistics go hand in hand from wherever accounting begins to wherever statistics ends."⁴

Limitations of Statistical Methods

When dealing with mathematical devices, it is common for a person to believe that because information is presented in the form of figures, it of necessity must be accurate. This fallacy is especially valid of accounting and statistical devices to the uninitiated. A Profit and Loss Statement may show that a concern has a profit for the period of thirty thousand two hundred and nine dollars and twenty-seven cents. (\$30,209.27). Because the profit is represented in the form of numerals and as it is assumed that anyone can count, the profit figure must be exact. The realization that one-third to one-half of that figure is comprised of estimates or judgments not controlled by accurate measuring devices does not seem to enter the mind of the ordinary person. The same is true of statistics. When one company says that its average monthly output of castings was two thousand, while another says that it had an average monthly output of one thousand, ordinarily the conclusion is drawn that the first company employs more people than the second company. Other factors will have to be taken into consideration

⁴Seymour L. Andrew, "Accounts and Statistics," A. R. S. & M. Journal, Vol. 9, No. 2, p. 1.

before any such inference can be drawn. The first company may make all of their castings the first three months of the year while the second one has its work evenly spread throughout the year. The first company may make extremely large castings while the second makes small castings.

It should be remembered, when dealing with statistical devices, that a knowledge of the means of computing results from these methods is not always mathematical. It is probably more important that the statistician have a knowledge of the field in which he is working than the mathematical methods of computing relationships. Relationships may seem to exist mathematically when they have no direct bearing upon each other in the business field. However, an open mind is necessary to see relationships which do exist between variables, although teaching and experience have at times contradicted these relationships.

CHAPTER II

GENERAL ACCOUNTING STATISTICAL METHODS

Classification of Accounts

Purpose of Classification

Before anyone can interpret or analyze large amounts of numerical data, that data has to be arranged in some logical form. In the process of collection of data to be analyzed, the problem of the degree of breakdown is first encountered. In any work which deals with analysis of numerical data, accounting or statistical, means of classifying the data should be considered.

There are several main purposes of account classification, the most important are:⁵

1. To serve as a guide for the accounting records.
2. To serve as an aid in the summarization of the transactions.
3. To regulate the preparation of financial statements.
4. To serve as a basis for statistical analysis.

While it is possible to compress all of the transactions of a business into one account, the disorder in the account would be

⁵William Rodney Thompson, Accounting Systems, LaSalle Extension University, 1940, p. 104.

a disadvantage to management rather than a help. To overcome any such difficulty, accounts are arranged so that information to guide the accountant, the management, and any others who may be interested in the records of the business may be found in orderly and useful categories.

Fundamentals of Account Classification

The purpose of classification in any scientific process is to assign to its proper group each occurrence of the individual type of phenomena. The accountant deals with financial and unit data, gathered from the transactions which have occurred in the business. To assign to its proper place each part of a transaction demands a knowledge of the particular business. All businesses have similar basic classifications, since that is the foundation upon which double-entry accounting has been developed. That is, all businesses have assets, liabilities, proprietorship, incomes and expenses. From this major division, the number of accounts which will be needed will depend, (1) upon the reliance of the firm on the accounting values; (2) upon the extent to which the accounting values are responsible, through presentation and analysis, for the direction or guidance of the firm.

Not all of the financial and operating data of a company will be derived from the accounts. Some analytical cost accounting is performed separately from value records in the accounts, but almost all system builders recommend the use of the double-entry accounting system for all types of accounting transactions because

of its natural check upon the work which has been accomplished. seldom does one find the suggestion that accounting data be kept separate from the accounts, although the use of the subsidiary ledger with its control account in the general ledger is often helpful.

The accounts, while not containing all of the information desired by a business, do have the basic facts regarding assets and the equities in those assets, both creditors' and owners' interests. In addition, changes in the assets and equities which result from business operations are recorded in the accounts. The general ledger has summary statements regarding all of the assets, liabilities, proprietorship, incomes, and expenses, while the subsidiary ledgers carry the detailed information regarding operations and financial conditions.

As the ledger accounts record changes in the financial items themselves and do not show all information about the original transactions, the degree to which the data is to be subdivided before summarization depends upon the information desired, and the purposes of subdivision. The detailed information regarding transactions and internal operations is recorded in the journals or registers, and then summaries of these items are carried to the accounts. Thus it can be seen that account classification tends to control procedures before recording values in the accounts and to determine the form in which the results are stated.

Heckert says that "classification of accounts is a systematic

arrangement of the ledger accounts for convenience in use.⁶ Accounts are arranged to furnish the most information with the least effort, and as a summary, Heckert gives the following major considerations in account classification:

The major considerations in the design of the classification of accounts may be summarized as follows:

1. It should be, all purposes considered, the most convenient arrangement of the accounts, both general and subsidiary.
2. It should be expressive of the major financial elements of the business.
3. It should reflect, in greater or less detail, the cost of operation, results, and relationships of cost and results.
4. It should "tie in" with the general organization, operations, and functions of the business in such manner as to be expressive of accountability for values and responsibility for results.
5. It should provide sufficient flexibility for normal growth and future changes in policy.
6. It should conform to legislation relative to federal and state taxes and such governmental regulations as may be applicable.
7. To the extent that the above considerations do not conflict, it should harmonize with the general practice of the industry.⁷

Account Titles and Symbols

To the present time accounting terminology has not been standardized highly enough to provide an acceptable term for each item in the accounts. Fortunately, attempts are being made through standardized accounting systems and government procedure to develop

⁶J. Brooks Heckert, Accounting Systems, The Ronald Press Company, New York, 1936, p. 77.

⁷Ibid., p. 78.

terminology which is acceptable and accurate.

About all that can be said at the present time about account titles is that the most descriptive term is the best. Usage demands certain titles for some accounts, but variation is so great that it is almost necessary for an accountant to have knowledge of a specific industry before he knows the titles of the accounts which are used regularly in that industry. The United States Department of Commerce has issued a bulletin which outlines the major account classifications appearing on statements to stockholders.⁸ The Securities and Exchange Commission and research committees of the American Institute of Accountants are also endeavoring to achieve a more uniform definition and classification of account titles.

Account Arrangement

The arrangement of the accounts in the ledger usually depends upon the reasons for, or purposes, of the accounting data. The broad base of account arrangement hinges upon the double-entry adaptation of assets, liabilities, proprietorship, incomes, and expenses. After the major group has been developed, sub-groups based upon the data which will be encountered in the business and somewhat of a breakdown of the major group are then developed.

⁸Committee on Statistical Reporting and Uniform Accounting for Industry of the Business Advisory and Planning Council for the Department of Commerce, Reports to Stockholders, U. S. Government Printing Office, Washington, 1934.

For instance, in almost all industries the assets will then be subdivided into current assets, fixed assets, and deferred charges. Other assets which are encountered are investments and intangibles. The above divisions are the main groups, but specific subtitles may be developed for any business or industry. Examples of subtitles are encountered in an investment house where the major title "Securities held for trade" is found, or in hospital accounting where the subtitle "Investment funds" is found. Differences in the subtitles are found more often in the incomes and expenses than they are found in the assets, liabilities and net worth. A person needs familiarity with a particular industry to be able adequately to label the accounts for that subject, e.g., in dealing with railroad accounting, specific titles are demanded for the operating accounts by the Interstate Commerce Commission. If one is not familiar with those accounts, it is not easy to understand the results of railroad operation. Titles are usually given which are most appropriate for that specific industry.

Controlling accounts eliminate much of the information which is subordinate to the general ledger. Arrangements and design of the subsidiary ledgers depend upon the information desired from those ledgers. However, the arrangement of the accounts of the subsidiary ledgers is not usually anything similar to the general ledger, as both of them have special purposes.

The general ledger accounts summarize transactions which appear on the major statements issued by the company. The balance sheet, the profit and loss statement, and sometimes the manufac-

turing statement come directly from the general ledger accounts. As the accounts are kept to provide this information on the statements, it is usually best to arrange the accounts in order of appearance on the statements. It should be remembered that a sufficient number of accounts to record the information desired should be kept in the ledger.

Whenever a business has many departments, usually the information is desired by departments rather than for the entire store. In such cases, the data will have to be recorded in accounts in the general ledger or control accounts set up in the general ledger with all of the desired information recorded in this subsidiary ledger.

Usually the arrangement of the accounts shows the following pattern:

1. Assets
2. Liabilities
3. Proprietorship
4. Incomes
5. Expenses

This arrangement varies somewhat as the deductions from such accounts as reserve for depreciation are sometimes located next to those accounts. Other income and other expenses which are not related directly to the operations of the business usually are placed last in the arrangement.

Subsidiary ledger arrangement follows a much less orderly pattern than general ledger arrangement, but usually the alphabetical, numerical, or geographical arrangement is followed. Accounts re-

reivable may be alphabetically classified, or, in many instances, may may be arranged by geographical division such as a city, state, or divisions of each before being classified numerically. Inventories may be arranged in numerous ways, but each item may be given a number or title and arrayed numerically or alphabetically.

Account Symbols

Through symbols, account classification is rendered easier. Access to the accounts is simplified when definite numbers or symbols are placed on the accounts. Various arrangements may be devised to code the accounts, but the following methods are usually employed:⁹

1. The numeral system
2. The decimal system
 - a. The Dewey decimal plan
 - b. Variations of the Dewey plan
3. The mnemonic system
4. The combined number and letter system

The numeral system. An arbitrary series of numbers is assigned to the various groups, such as Assets -- 100 to 199; Liabilities, Reserves, and Proprietorship -- 200 to 299; Sales, Returns, and Cost of Sales -- 300 to 599; Operating Expenses -- 600 to 899; and Other Income and Expenses -- 900 to 999. Detailed accounts falling within each group would have numbers corresponding to numbers within the limits of the group, such as Current Assets-Accounts -- 100 to 149,

⁹This information is condensed from Thompson, op. cit., pp. 122-145.

Fixed Assets -- 150 to 169, with all of the assets falling in accounts 100 to 199.

The decimal system. The following is quoted from Thompson:

The decimal system of coding is based upon the ten units of decimal numbers. Numbers from zero to nine (usually 1 to 9 in practice) are assigned to the major groups of the account classification, while subdivisions are expressed by the addition of a digit at the right. The first digit at the left allocates the account to a major group and the next digit to a subdivision within the group. The third digit generally refers to the particular primary account, as the title is to appear on the general ledger. If necessary, an additional digit may be added to indicate a subdivision of the general ledger account. This system was introduced several years ago by a man named Dewey as a plan for designating the classification of books in libraries so that it is often referred to as the Dewey decimal system.¹⁰

Division of the accounts into major groups may be made in various ways. However, under the Dewey decimal plan only nine or ten major groups are allowed. Variations of the Dewey decimal plan allow for any number of major groups. Divisions of the group and application of the system is similar to the Dewey decimal plan.

The decimal plan of account symbols has many advantages over other types because of its expansion possibilities, without changing many of the original account numbers.

Mnemonic system. Mnemonic refers to memory, and under the mnemonic system letters are adopted which are supposed to be similar to the spelling of the original account. Difficulty is some-

¹⁰Ibid., p. 124.

times encountered under the mnemonic system, since arbitrary letters must of necessity be used in any large group of accounts as the first letters of an account would soon be duplicated.

Combined number and letter system. Combinations of numbers and letters, with the letters standing for the major groups of accounts and the numbers referring to the accounts within the groups, are often satisfactory. For example, Cash may be A, with Cash in the First National Bank becoming A1, Cash in the City National Bank being A2, and Petty Cash as A3.

Illustration of Classification and Symbols

The following illustration is from the American Institute of Laundering's Revised System of Uniform Accounting. The illustration deals only with expenses and has eight natural divisions used as a basis for the decimal method of accounting coding. Only five of the eight natural divisions are given below:¹¹

1.--PRODUCTIVE LABOR

1.1--Productive Labor (laundering)

1.11--Identifying

1.111--Marking

1.112--Not Identifying

1.12--Washing and Extracting

1.121--Washing

1.122--Extracting

1.13--Tumbling and Drying

¹¹Doner E. Dewey, Director, "The A.I.L. Revised System of Uniform Accounting," American Institute of Laundering Service Bulletin No. 31, Joliet, Illinois, 1934.

1.1--Productive Labor (Laundering)--(Continued)**1.14--Ironing****1.141--Flatwork****1.142--Shirts****1.143--Handkerchiefs****1.144--Socks****1.145--Collar Starching, Ironing, Finishing****1.146--Soft Collar Ironing****1.147--Pressing (Wearing Apparel)****1.148--Hand Ironing (Wearing Apparel)****1.15--Assembling and Packaging****1.151--Damp Assembly****1.152--Assembling****1.153--Packaging****1.16--Productive Supervision****1.19--Other Productive Labor****1.191--Curtains****1.192--Blankets****1.193--Mending****1.194--Starching****1.2--Productive Labor (Dry Cleaning)****1.21--Marking and Cleaning****1.211--Receiving and Marking****1.212--Cleaning (Dry and Wet)****1.22--Spotting and Dyeing****1.221--Spotting****1.222--Dyeing****1.23--Repairing and Finishing****1.231--Repairing****1.232--Finishing****1.24--Operations not otherwise Classified****1.241--Rug Cleaning****1.242--Fur Cleaning and Repairing****1.25--Inspecting--Assembling, Packaging, etc.****1.251--Inspecting and Assembling****1.252--Packaging and Shipping****1.3--Outside Work****1.31--Laundry****1.32--Dry Cleaning, etc.****1.321--Garment Cleaning****1.322--Rug Cleaning****1.323--Hat Cleaning**

2.--PRODUCTIVE SUPPLIES**2.2--Nets and Marking Supplies****2.21--Nets****2.22--Other Marking Supplies****2.3--Washroom Supplies****2.31--Soap and Builder****2.311--Soap (Laundry)****2.312--Builder****2.32--Bleach, Sours and Blue****2.321--Bleach****2.322--Sours****2.323--Blue****2.33--Starch****2.34--Other Washroom Supplies****2.4--Water and Softener Supplies****2.41--Water****2.42--Softener****2.5--Ironing and Finishing Supplies****2.51--Aprons, Coverings and Pads****2.511--Aprons, Covers, Padding (Flatwork Dept.)****2.512--Coverings and Pads (Presses)****2.52--Other Ironing and Finishing Supplies****2.6--Packaging Supplies****2.61--Paper, Twine and Tape****2.611--Paper****2.612--Twine and Tape****2.62--Boxes and Bags****2.621--Boxes****2.622--Bags****2.63--Boards, Bands, Envelopes and Cases****2.631--Boards and Bands****2.632--Envelopes and Cases****2.64--Other Packaging Supplies****2.7--Dry Cleaning Supplies****2.71--Dry Cleaning Solvents****2.72--Other Dry Cleaning Supplies****2.721--Soaps and Chemicals****2.722--Dyes and Dyeing Supplies****2.723--Tailoring Supplies****2.724--Packaging Supplies****2.725--Other Dry Cleaning Supplies**

4.--BUILDING OVERHEAD**4.2--Rent--Laundry Building****4.3--Repairs and Maintenance (Labor and Supplies)****4.31--Repairs and Maintenance (Labor)****4.32--Repairs and Maintenance (Supplies)****4.4--Depreciation****4.5--Insurance****4.6--Taxes (Real Estate)****5.--LAUNDRY MACHINERY OVERHEAD****5.3--Repairs and Maintenance (Labor and Supplies)****5.31--Repairs and Maintenance (Labor)****5.32--Repairs and Maintenance (Supplies)****5.4--Depreciation****5.5--Insurance****5.6--Taxes (Personal Property)****7.--COLLECTION, DELIVERY AND SALES PROMOTION EXPENSES****7.1--Routemen's Wages and Commissions****7.11--Routemen's Wages and Commission--Laundry--Retail****7.12--Routemen's Wages and Commission--Laundry--Wholesale****7.13--Routemen's Wages and Commission--Dry Cleaning****7.14--Routemen's Wages and Commission--Linen Supply****7.2--Route Supervision****7.21--Route Superintendents****7.22--Route Foremen****7.3--Delivery Equipment Operating Expense****7.31--Repairs--Labor, Parts and Supplies****7.311--Repairs--Labor****7.312--Repairs--Parts and Supplies****7.32--Gas, Oil and Grease****7.321--Gasoline****7.322--Oil and Grease**

7.3--Delivery Equipment Operating Expense (Continued)

- 7.33--Tires and Tubes
- 7.34--Electric Truck Expense
- 7.35--Horse and Stable Expense
- 7.36--Other Delivery Equipment Operating Expense
 - 7.361--Garage--Rent and Other Expense
 - 7.362--Vehicle Taxes and Licenses
 - 7.363--Painting, Lettering, etc.

7.4--Depreciation--Equipment

- 7.41--Depreciation--Delivery Equipment
 - 7.411--Depreciation--Gasoline Trucks
 - 7.412--Depreciation--Electric Trucks
 - 7.413--Depreciation--Other Vehicles
- 7.42--Depreciation--Other Vehicles
 - 7.421--Depreciation--Bampers, Bins, etc.
 - 7.422--Depreciation--Garage Equipment

7.5--Liability and Other Insurance

- 7.51--Liability and Property Insurance
- 7.52--Compensation Insurance

7.6--Agency, Branch and Call Office Expense

- 7.61--Agency Expense
 - 7.611--Agency Commissions
 - 7.612--Agency Express and Parcel Post
 - 7.613--Other Agency Expense
- 7.62--Branch and Call Office Expense
 - 7.621--Branch and Call Office Salaries
 - 7.622--Branch and Call Office--Discounts
 - 7.623--Branch and Call Office--Rent
 - 7.624--Branch and Call Office--Other Expenses

7.7--Advertising and Publicity

- 7.71--Advertising--Newspaper
- 7.72--Advertising--Direct Mail
- 7.73--Advertising--Bundle Inserts
- 7.74--Advertising--Posters and Bill Boards
- 7.75--Advertising--Radio
- 7.76--Direct Publicity
- 7.77--Other advertising and Publicity

7.—COLLECTION, DELIVERY AND SALES PROMOTION EXPENSES (Continued)

7.8--Sales Promotion Salaries and Expense

- 7.81--Sales Manager's Salary
- 7.82--Service Department Salaries
- 7.83--Solicitors' Salaries and Expense
 - 7.831--Solicitors' Salaries
 - 7.832--Solicitors' Expense
- 7.84--Other Sales Promotion Expense
 - 7.841--Sales Contests and Prizes
 - 7.842--Sales Meeting Expense
 - 7.843--Stationery and Printing--Sales

7.9--Claim Adjustments

- 7.91--Claim Adjustments--Laundry
- 7.92--Claim Adjustments--Dry Cleaning

Statistical Classification

In dealing with accounting data which is to be further analyzed statistically, classification of a different type from that previously mentioned will be necessary. Usually the classification of accounts is so arranged that it will facilitate any statistical analysis beyond the common accounting statements.

The accountant will have the greatest share of his statistical data already collected for him in his accounting records. It must be remembered that in dealing with numerical data, the purpose of statistical analysis is to have one or a few items represent a great many. In classifying either the financial or unit data, which may be found in accounting records, into further class intervals, some methods of dividing this information into homogeneous groups will have to be decided upon. Sales by departments will have to be stated in one common denominator such as sales dollars. Labor analysis will necessitate division into hours or units of production.

The specific differences between individual series may be classified into four major groups or bases. They are:

1. Qualitative
2. Quantitative
3. Time
4. Geographic location

Qualitative. Separating accounting data into specific degrees of quality or its special traits may be illustrated in the analysis of labor. Union or non-union employees, white or negro laborers, and skilled or unskilled workers are all illustrations of the qualitative subdivision.

Quantitative. Salesmen may be classified by the amount each sells, and numerous branches of a company may be classified by the amount of working capital employed at that branch. The purpose behind quantitative classification is to break the numerous items down in terms of specific quantities.

Time. The time classification is used a great deal in accounting-statistical analysis. As the industrial organization is a dynamic group and information from day-to-day, month-to-month, and year-to-year is important for successful operation of the business, much of the numerical facts of the business are stated in terms of some time classification.

Geographic location. The geographical classification is used more by a large concern than by a small one, but it is possible to analyze sales, even in small cities, by geographical distribution. Large concerns enjoying national or international distribution would

depend upon this type of classification for special statistical studies.

In addition to the above major statistical classifications, it is also possible to cross classify the data available to reduce the information to a more usable function. For example, it is possible to classify data into time and quantitative functions: that is, the sales of salesmen by months. By a further break-down, the sales by months for various districts and as a total may be obtained. Although it is possible to further classify the data into sales by months, by districts, and by commodities, whenever too many classifications are attempted, usually chaos rather than order is the result.

CHAPTER III

GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED

Percentages and Ratios

Comparisons between actual figures are sometimes difficult, and then derived figures which have a common base are more useful in making comparisons between data. For example, it may be said that the sales for one department is \$123,567.95; sales for another department is \$43,865.52. The cost of the goods sold in the first department is \$74,255.52 while that of the second department is \$30,782.27. Is there any relationship between the cost of goods in the first department and in the second department? Unless a person is extremely familiar with numerical data, it is difficult for him to associate these separate figures. By reducing them to some common base, however, association can readily be obtained. The base which is commonly used is one hundred, and the term percentage, which comes from the Latin "per centum" meaning hundredths, is applied to this calculation. When one number is expressed in terms of another number, the term ratio is applied. These two figures may be reduced to the lowest common denominator for ready comparison. To illustrate this, if current assets are \$125,000 while current liabilities are \$50,000, the

ratio is 125,000 divided by 50,000 or two and one-half to one. In certain cases it is better to leave the comparison in terms of a ratio rather than to express it as a percentage.

Percentages

From the accounting viewpoint there are three different types of problems involved in percentages. They are:¹²

1. Finding what per cent one number is of another.
2. Finding a per cent of a number.
3. Finding a number when a per cent of it is known.

Although percentages are taught in high schools and colleges, in general arithmetic and mathematic courses, many of the uses of percentages are statistical; and because of a lack of knowledge of relationships which exist in percentages, some statisticians have portrayed results which are not exactly true.¹³ The statistical uses of percentages by accountants and errors in usage, as well as the appropriate methods, will be developed in this and subsequent chapters.

Methods of computing percentages

Although the methods of computing percentages are probably known

¹²Seymour Walton and H. A. Finney, Mathematics of Accounting and Finance, The Ronald Press Co., New York, 1921, pp. 50-51.

¹³For definite examples of this statement see Frederick B. Cotton and Dudley J. Cowden, Applied General Statistics, Prentice-Hall, Inc., New York, 1939, pp. 159-162; and Robert E. Chaddock, Principles and Methods of Statistics, Houghton Mifflin Company, Boston, 1925, pp. 15-22.

to the majority of accountants, a brief description of these procedures will be helpful, especially when more complex descriptions of the methods are examined.

Percentages are similar to fractions and ratios, with the exception that percentages are stated in terms of a decimal equivalent. One per cent (1%) is the same as one-tenth ($1/10$) or the decimal .10, ten-hundredths. The base, the number to which comparisons are being made, is divided into the figure being compared to obtain a decimal fraction. By multiplying by 100 this decimal fraction is converted into percentages. It may be seen from the above illustration that one number is stated in terms of another number, and because of this, in statistical methods, percentages are often referred to as relatives. Examples of finding what per cent one number is of another are numerous in accounting. The ratios used in statement analysis are all based upon this type of problem. For example, if the sales of a company are found to be \$100,000 while the depreciation is \$12,000, the relationship between the depreciation and the sales is found by dividing the depreciation by the sales, which in this case is .12 or in terms of percentages, 12%. The base is always divided into the figures being compared.

Whenever the percentage rate is known, it is always possible to find the percent of any desired number. For example, the depreciation rate on the buildings of a company is 4%. The buildings are valued at \$300,000. How much is the depreciation? The base in this case is the value of the buildings. To find the relative valuation (depreciation) to the buildings which equals 4%, \$300,000 is multiplied

.04 which gives \$12,000. It may be noticed that while the depreciation to the building is 4%, the depreciation to the sales as given above is 12%. By changing bases different depreciation rates are required. It is always important in any type of percentage work to know what the base is, as a percentage figure lacks meaning unless the base is definitely known or can be determined.

The other type of problem involving percentages, that of finding a number when a per cent of it is known, may be illustrated from the foregoing examples. In the first example, the rate of depreciation to the sales is 12%. If the depreciation is known to be \$12,000, how much is the sales? By dividing the percentage rate as a decimal equivalent, .12, into the known depreciation, \$12,000, the answer of \$100,000 for the sales is obtained. In the second example, the rate of depreciation is 4% and the depreciation on the buildings is \$12,000. To obtain the value of the building .04 is divided into the known amount of depreciation, \$12,000, to derive the value of the buildings which is \$300,000.

A variation of the above type of problem is encountered in mark-up where the base is the retail sales value of the goods. To determine the sales price when the cost and the mark-up percentages are known, subtract the mark-up percentage from 100% and then divide the result into the cost price. To illustrate, if the cost of an article is \$80.00 and the mark-up is 40%, subtract the 40% mark-up, from 100%, the sales price, and the result is 60%, which represents the cost. Divide this 60% into \$80.00 and the result is \$133.33, the sales price.

Errors are often made through the imperfect use of percentages. Croxton and Cowden list the following difficulties due to calculation and use of faulty percentages: "(1) confusion in regard to base, (2) calculation of percentages based on small absolute number, (3) misplaced decimal points, (4) arithmetic mistakes, (5) improper procedures in averaging percentages, (6) the use of percentages which are awkwardly large."¹⁴

In the preceding illustration regarding depreciation, the base is changed in each illustration. By such change in base, the corresponding depreciation rate is also changed. No comparison should be made between these two depreciation rates, as they are not based on comparable data. Bases should be noted especially in the comparison of index numbers, for if they are not based upon the same data, the index numbers themselves are not comparable.

Whenever a small absolute number is used as the base in determining percentages, the wrong impression is often given. If only one or two items are included in a percentage relationship, the rate must be either 0%, 50%, or 100%. The percentage rate seems to raise the importance of the original figure when making comparisons, and if small numbers are used as a base, they should accompany the percentage or a percentage should not be used at all.

One can easily see that 40% is not the same as .40%, yet there are still occasions where these major differences are overlooked. In examining statements with percentage relationships, the differences in the placing of decimal points should be especially noted.

¹⁴Croxton and Cowden, *op. cit.*, p. 159.

The methods of properly averaging percentages will be discussed in the chapter dealing with averages. Whenever percentages are extremely large, it is usually better to use the simple fraction ratio rather than the percentage ratio. This idea is illustrated whenever the so-called current ratio is discussed. A rule of thumb method says that the current assets should be at least twice the amount of the current liabilities. This is much better than saying that the current assets should be 200% as great as the current liabilities.

Application of Percentages and Ratios to Accounting Problems

While there are many applications of percentages which will not be discussed at the present time, those applications which pertain to business as a part of the accounting records are explained. The use of percentages in the analysis of statements and in specialized statistical fields such as index numbers, seasonal indexes, and cyclical incomes will be examined under those headings. Special application of percentages to specific accounting fields such as cost accounting and public accounting will also be explained under those topics.

Discounts

Discounts may be considered from two viewpoints: (1) cash discounts and (2) trade discounts. Either case is a simple application of percentage methods. The expression "Terms: 2%/10, n/30" means that 2% of the invoice price will be deducted if the payment is made within ten days, and that the invoice is due without any discount after ten days but before thirty days. If 2% of the invoice price is deducted from the goods as a cash discount, then 98% of the in-

the price must be paid. When the payment and the discount are given, then the invoice price may be obtained by dividing the payment by 98%.

Trade discounts may either be given individually or in series. If only one discount is given, then the rules of percentages are applied. If more than one percentage is given, the several discounts are not equal to their sum. Neither is the product of the several discounts equal to the single discount. There are two methods of arriving at a single discount equal to a group of discounts, as described by Curtis and Cooper:

First Method—To find the single discount that is equivalent to a series of discounts, subtract one of the discounts from 100%. Use the remainder as a new base. Multiply it by the second discount, and deduct the product. Use this remainder as a new base. Compute each discount successively, proceeding as before. The difference between 100% and the last result will be the single discount.

Second Method—To find the single discount that is equivalent to a series of discounts, subtract each single discount from 100, and find the product of the remainders. Subtract the final product from 100%, and the remainder is the single discount equivalent to the series of discounts.¹⁵

Another type of discount is often encountered in accounting terminology--discount on notes. This is a type of interest and an attempt will be made to explain the different kinds of interest.

of Percentage and Ratios in Partnership Accounting

The use of ratios and percentages in partnership accounting

¹⁵A. E. Curtis and J. H. Cooper, Mathematics of Accounting, revised edition, Prentice-Hall, Inc., New York, 1940, pp. 84-85.

may be classified under three headings:

1. Division of profits.
2. Admission of new partners.
3. Liquidation of partnership.

There are various methods of division of profits of a partnership, but some of the customary methods are:¹⁶

- (1) In an equal ratio.
- (2) In an arbitrary ratio.
- (3) In the capital ratio.
- (4) In the average capital ratio.
- (5) By allowing interest on capitals and dividing the remaining profit in an agreed ratio.
- (6) By allowing salaries to the partners and dividing the remaining profits in an agreed ratio.

The first three methods use ratio and percentage principles entirely. In the fourth method it is necessary to understand how to apportion the capital for the time invested. From then on, the division is performed exactly as has been described above in the methods of computing percentages. Whenever ratios are used instead of percentages, the fraction method of computing the different rates is used instead of the decimal method; that is, if the ratios of profits is 40, 30, 20, then the first partner receives $40/90$, the second partner $30/90$, and the third partner $20/90$. Then the fractions may be converted to percentages with the first partner receiving $44\frac{2}{3}\%$, the

¹⁶H. A. Finney, Principles of Accounting, Volume II, Advanced, Rentice-Hall, Inc., New York, 1938, p. 4.

the second $37\frac{1}{2}\%$, and the third 25%.

When distributing profits by the last two methods, it must be remembered that interest or salaries must be deducted from or added to the profit before the actual ratio distribution is attempted. If a profit amount has been reduced to a debit balance through the subtraction of interest and salaries, then the debit balance would be distributed in the profit and loss ratio.

Use of Ratio and Percentages in Estimating Depreciation

Depreciation has two special meanings: (1) the process whereby the useful value of an asset has become less valuable through wear, tear, and deterioration, and (2) the amount of a useful asset which is consumed in the operation of a business through wear, tear, and deterioration. Both meanings have the same concepts; one, however, is based on the process while the other is based on the amount. In any case both deal with the gradual diminishing of the asset, and the various ways in which this diminishing can be estimated and recorded in the books are sometimes connected with percentages.

Paton, in the Accountant's Handbook, makes the following statement regarding the various bases which may be used in computing depreciation:

DEPRECIATION BASES--The question of the measure of the amount of depreciation with respect to a particular unit or to a plant as a whole is not fully settled. The principal possible bases--all of which have some standing--are:

1. Cost, either entire or adjusted.
2. Cost plus maintenance.
3. Replacement or reproduction cost.

4. Present Value (usually determined by appraisal).
5. Special income tax bases.¹⁷

When the base is determined, which in most instances of a manufacturing concern is the cost, the method of arriving at the amount set aside in the records as the depreciation allowance must be settled. There are six recognized methods of depreciation, viz.:

- (1) Straight-line method.
- (2) Working-hour method, or unit-product method.
- (3) Sum of digits method.
- (4) Sinking-fund method.
- (5) Annuity method.
- (6) Fixed-percentage-of-diminishing-value method.¹⁸

Each of the methods has ratios or percentages as the basic procedure in determining the depreciation amount. Under the straight-line method the rate of depreciation may be stated in terms of percentage or in terms of number of years. If a machine valued at \$10,000.00 is to be depreciated at the rate of 10%, then .10 times \$10,000.00 gives \$1,000.00 the annual depreciation rate. The annual depreciation rate of 10% is derived from the number of years, ten, which the machine lasts. If the above machine, which could be operated approximately 20,000 hours in the ten years, under ordinary conditions, operates 5,000 hours in the first year, depreciation

¹⁷W. A. Paton, Editor, Accountant's Handbook, Second Edition, Ronald Press Company, 1934, p. 593.

¹⁸Curtis and Cooper, op. cit., p. 381.

for the machine would be at the rate of 25% rather than 10%. When operating conditions fluctuate widely, the working-hours or unit-product method is sometimes used.

The sum-of-digits method is used when the depreciation is greater in the early years than in the later years. To find the amount to charge each period, add the sum of the digits or periods of life of the asset. Use the ratio between the inverse order of the digits and the sum to find the depreciation amount. For example, if the value of a machine is \$1,000 and the machine lasts five years, add the digits together, $1 + 2 + 3 + 4 + 5 = 15$. In inverse order $5/15 \times \$1,000 = \333.33 , $4/15 \times \$1,000 = \266.67 , $3/15 \times \$1,000 = \200.00 , $2/15 \times \$1,000 = \133.33 , and $1/15 \times \$1,000 = \66.67 . The total of the depreciation is \$1,000, but the early years receive the greater amounts.

In determining depreciation by the sinking fund method and the annuity method, interest is calculated before determining the annual depreciation charge. Under the fixed-percentage-of-diminishing-value method, the same percentage rate is used each year, but the value of the asset decreases. The determination of the percentage rate which is used involves the use of logarithms.

The Retail Method of Inventory

Accountants have adapted the uses of percentages to one of their important functions in retail accounting through the retail method of inventory. The application of the retail method of inventory is restricted to establishments which sell goods in the form received and

cannot be adapted to industries which manufacture or process goods.

The value placed upon the inventory is one of the important elements in determining profits. Two methods are employed to obtain the correct inventory value when perpetual inventories records are kept in retail establishments--the cost method and the retail method. Both are used at the present time; however, the retail method of inventory is newer and is an improvement on the cost method of keeping inventory records.

Under the cost method, actual costs are entered upon the sales invoice either in code or by code reference to the original purchase invoice. When the physical inventory is taken at the end of a period, transportation charges and depreciation of the merchandise must be allocated to the total cost of the goods on hand.

Under the retail method of inventory, the physical inventory at the end of the period for each department is made at the current retail selling prices by reference to the price tickets. The mark-up percentage on the total merchandise handled is determined for each department and through the use of this mark-up percentage and the retail selling price, the cost or market value of the inventory is determined.

The fundamentals of the retail method of inventory is illustrated below:

	<u>Cost</u>	<u>Retail</u>	<u>Markup</u>	<u>Markup %</u>
Inventory at beginning of period	\$ 5,000	\$ 8,000	\$ 3,000	37½
Purchases during period	<u>20,000</u>	<u>32,000</u>	<u>12,000</u>	<u>37½</u>
Total Merchandise	\$25,000	\$40,000	\$15,000	37½
Retail Inventory at end of period		24,000		
Markup (37½% x \$24,000)			9,000	
Cost Inventory at end of period (\$24,000 - \$9,000 or 62.5% x \$24,000)	<u>15,000</u>			
Cost of merchandise sold	\$10,000	<u>\$16,000</u>		

However, in practice more complex conditions are encountered. The following are special factors found in dealing with the retail method of inventory:

1. Variation in margin between classes of merchandise between periods of operation.
2. Changes in prices as first marked--additional mark-ups and mark-downs.
3. Discounts and allowances applicable to invoice costs and sales.
4. Transportation and other charges applicable to merchandise.
5. Discrepancies and errors from various causes.¹⁹

When the margin between different classes of merchandise in the same department is not fairly comparable, the mark-up percentage will not be representative of the department. Different lines carrying different mark-ups will not always be represented in closing stocks in proportion to the total merchandise handled. A solution to the problem of high and low mark-ups comes by separating the high and low mark-up goods into separate departments, or by charging special purchases into stock at the regular mark-up and then reducing this by means of a mark-down.

The mark-up percentage, or the mark-on percentage as it is commonly called when the difference between the cost and the retail of the total merchandise handled is divided by the retail, is not affected by the mark-downs, since they are not deducted from the retail in computing the total merchandise handled.²⁰ The mark-downs auto-

¹⁹W. A. Paton, *Editor, op. cit.*, p. 437.

²⁰John W. Wingate and Morris A. Brisco, Elements of Retail Merchandising, Prentice-Hall, Inc., New York, 1938, pp. 76-77 and 397.

atically reflect cost or market, whichever is lower, in the inventory, when they are added to the actual sales of the department. The total deductions--actual sales plus the mark-downs--subtracted from the total merchandise handled at retail, will give the inventory at retail. By not subtracting the mark-downs from the retail amount of the inventory, the mark-on percentage will more accurately reflect actual conditions. However, additional mark-ups or revisions in retail downward must be taken into consideration in the retail price in computing the mark-on percentage. The additional mark-ups would increase the mark-on percentage while the revision in the retail price downward would decrease the mark-on percentage. In either case, the mark-on percentage would be accurate, but if the mark-downs are deducted from the retail value of the merchandise rather than from the sales, the inventory is overstated. The following examples illustrate these principles:

	<u>Cost</u>	<u>Retail</u>	<u>Markon</u>
Opening Inventory	\$10,000	15,000	33 1/3%
Purchases	<u>20,000</u>	<u>30,000</u>	<u>33 1/3%</u>
Total Merchandise	\$30,000	45,000	33 1/3%
Sales	\$25,000		
Markdowns	<u>3,000</u>		
Total Deductions		<u>27,000</u>	
Inventory at Retail		18,000	
Inventory at Cost	<u>12,000</u>		
66 2/3% x \$ 18,000			

When the mark-downs are deducted from the retail after the mark-on percentage has been calculated, the inventory at retail is shown at the present market price. When reduced to a cost basis, the inventory is the lower of cost or market. If the \$2,000 had been de-

deducted from retail before computing the mark-on percentage, the retail value of the total merchandise would have been:

Opening Inventory	\$15,000
Purchases	<u>30,000</u>
Total	\$45,000
Less Markdowns	<u>2,000</u>
Retail Value of Merchandise	\$43,000
Cost of Merchandise	<u>30,000</u>
Markon Percentage	30.2%
Value of Merchandise at Cost	\$12,564

The inventory would have been overstated by \$564.00 with the deduction of mark-downs from the retail price before calculating the mark-on percentage.

The following statement summarizes the possibilities of the retail method of inventory:

The retail inventory method makes possible a more rapid taking of the periodic physical inventory than is the case when original costs must be identified with units on hand. Furthermore, by keeping records of original pricings, net markups, and net markdowns, it is possible to calculate the inventory at any time for purposes of interim statements or the determination of inventory position. This method, however, is not entirely satisfactory unless the original rate of markup within an organization is fairly uniform, or unless high and low margin items sell in the same proportion. Where different percentage markups are applied, difficulties may be overcome by maintaining separate records and computing separate cost percentages for the different departments in the organization or for the different classes of merchandise sold.²¹

²¹Howard S. Noble, Wilbert L. Karrenbrock, and Harry Simons, *Advanced Accounting*, Southwestern Publishing Company, Cincinnati, 1941.

Miscellaneous accounting uses of ratios and percentages

Ratios and percentages may be used in any type of mathematical problem where there is a comparison between two or more numbers. Although there are numerous conditions where ratios and percentages may be employed, only a few accounting uses are developed in this paper. The preceding uses of ratios and percentages are the most important, but the following conditions may warrant a knowledge of this statistical device.

Dividends. Dividends are usually paid in terms of so many dollars per share or so much per cent per share. The amount paid per share or the total amount of the dividend payment may be calculated if the ratio or percentage is known.

Interest. Interest is an application of percentages. Knowledge of the conditions of percentages is helpful to those accountants who deal with interest, as the basic procedure is similar.

Income and Sales Tax. Tax rates are determined by certain percentages for normal and surtax brackets. Sales tax is collected as a percentage of net sales. There are instances where the sales and the sales tax are added together. To separate the total into sales and sales tax, divide the total by 100% plus the sales tax percentage. For example, if the sales tax is 1% of the net sales and the total of sales and sales tax is \$202,000, divide \$202,000 by 101%, which results in \$200,000, the sales. The sales tax is then \$2,000.

Consolidated Statements. To determine the amount of investment which one company has in others, the percentage method is often en-

ployed. In either the cost method or in the equity method of recording stock purchased for control of another corporation, the percentage of stock purchased to total stock outstanding determines the amount of the investment, capital stock, and surplus to eliminate in combining the various statements.

As ratio and percentage analysis of financial statements has developed into a field of its own, the following chapter of the paper is devoted to the analysis of financial statements.

Percentage of Bad Debts to Sales. To determine the amount of bad debts to charge each year, find the average percentage of the bad debts to sales or receivable and use in the future.

CHAPTER IV

GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED

Ratio Analysis of Single Financial Statements

Ratio and Percentage Analysis in General

Guthman makes the following statement regarding the construction and analysis of financial statements:

Among the subjects interesting to those connected with the administration of business is that of financial statements, a subject which may be studied from either of two viewpoints--construction or analysis. The construction of financial statements is the work of the accountant, and an ever-increasing number of accounting textbooks are devoted to an exposition of that field. The present volume, however, is concerned with the analysis and interpretation of financial statements, which is the aspect of the subject having the more general interest. For every accountant engaged in the work of statement construction, large numbers of persons are interested in the use of that statement--the executives, who need information the better to guide the destinies of the business; the bankers, who must have sufficient information to justify the making of loans; credit managers, who require adequate facts as a basis upon which to extend credit; and investors, who demand a sufficient record of financial success to warrant their purchase of the securities of the business. Even the accountant will find it valuable to study the analytical side of financial statements, in order to acquire the viewpoint of the users of his product, and to give his work more than mere technical accuracy such as is required of credited statements. His reports should be so framed as to possess a maximum of usefulness for interpreting the financial situation they are intended

to picture.²²

Ratio and percentage analysis of financial statements is a use of the statistical device of percentages and ratios as applied to accounting statements. As is suggested in the foregoing quotation, analysis of financial statements is done by others as well as by the accountant; however, he should have a knowledge of the technical procedure of statement analysis so that he may be able to understand better what others desire of him. Although the procedures of analysing statements do not yet achieve results which class statement analysis as a science, progress is being made in that direction. Many of the types of ratio and percentage analysis of statements come under the classification of other statistical devices such as trends, index numbers, and averages; explanation of the special types of ratios and percentages are explained under the appropriate classifications in other chapters.

There are many methods of approach to the use of ratios and percentages in statement analysis. Since the accountant is the one to whom the present paper is directed, the presentation of ratio analysis of financial statements in this paper will be in terms of the major accounting statements--the balance sheet and the profit and loss statement, and a combination of the items on the two statements.

²²Harry G. Guthmann, The Analysis of Financial Statements, Revised Edition, Prentice-Hall, Inc., New York, 1936, p. 3.

Analysis of items on a balance sheet or other accounting statements also is done otherwise than by ratios and percentages. Subjective analysis is as important as objective, and it is of utmost importance for the accountant to know that the information recorded on the statements of a business is as true and accurate as is humanly possible before attempting to analyze it. Ratios and percentages, while probably the most important of the statistical devices used to analyze financial statements, have their limitations. One authority on the analysis of industrial securities makes the following statement:

Many analysts have become so enthusiastic over the possibilities in the use of ratios as to believe that they can be used as an absolute yardstick and detector of virtually all industrial ailments. Some advocates of the ratios have even gone so far as to maintain that any function of an industry that is not normal can be quickly and accurately determined through the ratio method. This degree of faith in the use of ratios as a cure-all is hardly justifiable, and the method can only be used as one of the many means of suggesting where certain financial weaknesses may exist. Ratios cannot in themselves be used blindly as exact measures of financial performance.²³

Comparative analysis of financial statements is probably more valuable than analysis of single statements, and will be considered under the separate title of "Trends." Analysis of single statements, however, is the basis for the analytical method employed in determining trends from comparative statement.

²³Carl Kraft and Louis P. Starkweather, Analysis of Industrial Securities, The Ronald Press Company, New York, 1930, p. 119.

Balance Sheet Analysis

Relationship Between Individual Items or Sections to Totals.

When the balance sheet is constructed, percentage analysis can be provided together with the balance sheet to show relationships that exist between individual items or sections to totals on the balance sheet. Each asset is expressed as a percentage of total assets; each asset may be expressed as a percentage of the section of assets in which it appears; or each class of assets may be expressed as a percentage of the total assets. Likewise, the liabilities and the net worth may be shown as a percentage of the total equities. To illustrate the foregoing, the following balance sheet of the Jones Manufacturing Company (Illustration I) is given on pages 53 and 54.

Illustration I
JONES MANUFACTURING COMPANY
Balance Sheet
December 31, 1943

<u>Assets</u>				
<u>Current Assets:</u>				
Cash		\$18,000.00	38.7%	
Petty Cash		100.00	.2	
Accounts Receivable				
Reserve for Bad Debts				
Book Value		14,850.00	32.0	
Notes Receivable				
Notes Receivable Discounted		3,000.00	6.5	
Accrued Interest on Notes Receivable		15.00	.0	
Inventories:				
Raw Materials			4.3	
Goods in Process			9.7	
Finished Goods			8.6	
Total Inventories		10,500.00	22.6	
Total Current Assets			100.0	\$46,465.00 46.5%
<u>Fixed Assets:</u>				
Land		9,000.00	16.9	
Building				
Reserve for Depreciation				
Book Value		34,000.00	45.2	
Machinery				
Reserve for Depreciation				
Book Value		17,000.00	32.0	
Tools		2,000.00	3.8	
Office Equipment				
Reserve for Depreciation				
Book Value		1,100.00	2.4	
Total Fixed Assets			100.0	53,100.00 53.1
Deferred Charges:				
Prepaid Insurance		250.00		
Factory Supplies		185.00		
Total Deferred Charges				435.00 .4
Total Assets				100,000.00 100.0

Liabilities and Capital

Current Liabilities:

Accounts Payable
Bank Loans
Accrued Interest Payable
Accrued Wages
Provisions for Income Tax
Total Current Liabilities

\$9,000.00
5,000.00
200.00
150.00
1,000.00

58.6%
32.6
1.3
1.0
6.5

100.0% \$15,350.00 15.3%

Fixed Liabilities:

Bonds Payable

30,000.00 30.0

Capital:

Capital Stock Common
Surplus
Total Capital
Total Liabilities and Capital

\$50,000.00
4,650.00

91.5%
8.5
100.0

54,650.00 54.7
100,000.00 100.0

It may be noticed from the above balance sheet that the major percentages are:²⁴

1. Per cent of each current asset to total current assets.
2. Per cent of each fixed asset to total fixed assets.
3. Per cent of each reserve to its related asset account.
4. Per cent of each class of assets to total assets.
5. Per cent of each current liability to total liabilities.
6. Similarly for all groups on the balance sheet.

Current Ratio. The current ratio is a measure of the current or working capital position of the company and is computed by dividing the current assets by the current liabilities. In the above balance sheet, the current ratio is found by dividing the current assets, \$46,465, by the current liabilities, \$15,350, which gives the ratio of approximately 3:1.

The excess of the current assets over the current liabilities is an important factor in determining the ability of the company to pay current debts, but the ratio between the current assets and the current liabilities is of even greater importance than the absolute amount of the working capital. This is shown by the following illustration:

	X's Business	Y's Business
Current Assets	\$40,000	\$275,000
Current Liabilities	15,000	250,000
Working Capital	\$25,000	\$25,000
Working Capital Ratio	2.67 to 1	1.1 to 1

²⁴The above analysis is similar to the discussion by H. A. Finney, Principles of Accounting, Volume I, Prentice-Hall, Inc., New York, 1936, Chapter 4, pp. 6 and 12-15.

Note that one of the rules of percentages and ratios is adhered to in making and presenting the current ratio. Whenever percentages are large, it is usually better to express the ratios as whole numbers than as percentages. Seldom does one find the current ratio expressed as a percentage, for usually the current assets are twice or more as large as the current liabilities. Neither does the rule-of-thumb statement that current assets have to be at least twice as large as current liabilities apply in all cases.

Cash to Bank Loans (or Notes Payable.) This ratio is a valuable ratio to test the cash position of a company, as payment of bank loans or notes is usually essential to continued existence. By reference to the balance sheet given above, it may be seen that the ratio is \$18,000 cash to \$5,000 bank loans, or a ratio of 3.6 to 1.

Cash to Current Liabilities. The ratio of Cash to the Current Liabilities is determined by dividing the cash by the total current liabilities. This ratio shows the ease of liquidity of all of the current liabilities. By reference to the foregoing balance sheet, Cash, \$18,000, divided by the Current Liabilities, \$15,350, gives a ratio of 1.2 to 1. In the above two illustrations it may have been noticed that the cash position is especially strong. Too much cash, however, is not always indicative of a strong company, since an extremely strong cash position may indicate that the company is not profitably investing all of its capital.

Quick Ratio. The quick ratio is often called the acid test ratio, as the purpose of the ratio is to determine if the company

is able to meet its current obligations without depending upon its inventories, or in other words, if the assets which will be turned into cash immediately will be sufficient to pay for the current debts. The quick ratio is computed by dividing the current liabilities into the total of the cash and the receivables, or, stated differently, current assets minus the inventories divided by the current liabilities equals the quick ratio. In the above balance sheet the current assets of \$46,465 minus the inventories, \$10,500, leaves quick assets of \$35,945. When the quick assets are divided by the current liabilities of \$15,350, the quick ratio of 2.3 to 1 is derived.

Percentage of net current assets invested in inventories. To determine the net current assets, subtract the current liabilities from the current assets. The ratio between the net current assets and the inventories will sometimes show when there has been an over-expansion of inventories.

Fixed Assets to Fixed Liabilities. To find the ratio of fixed assets to fixed liabilities, the total of the fixed liabilities is divided into the fixed assets. This ratio is computed to determine the proportion of fixed assets which are related to funded debt. Usually, when computing the ratio of fixed assets to fixed liabilities, a sinking fund for the retirement of the bonds should be deducted from the unpaid balance of the bond issue before computing the ratio.

When the book values on the accounting statement are accurate, and reflect the true condition of the value of the assets, the ratio calculated by dividing the book value of the fixed assets by the book

value of the funded debt is more accurate than that determined by other methods. In the last decade or two, however, values have been determined by methods other than cost as determined from the accounting records. Since accountants use cost to reflect the value of the assets, the real value may be quite different than the cost value. An additional method of computing the ratio between fixed assets and fixed liabilities may be determined from the market value of the stock. The theoretical market value of the stock is determined from the earning power of the assets, so it is possible to determine the ratio of assets to bonded debt by using the market price of the stock rather than the book value of the assets.

The equation $\text{Assets} - \text{Liabilities} = \text{Net Worth}$ is fundamental in accounting. By subtracting the current liabilities from the assets, the equation becomes: $\text{Net Assets} - \text{Funded Debt} = \text{Net Worth}$. If the entire equation is divided by the Funded Debt, then the equation would be:

$$\frac{\text{Net Assets}}{\text{Funded Debt}} - \frac{\text{Funded Debt}}{\text{Funded Debt}} = \frac{\text{Net Worth}}{\text{Funded Debt}}$$

or

$$\frac{\text{Net Assets}}{\text{Funded Debt}} - 1 = \frac{\text{Net Worth}}{\text{Funded Debt}}$$

If the Net Worth is determined by taking the market price per share of stock and multiplying this by the number of shares outstanding, then, when this is divided by the Funded Debt, it will show the ratio of the net assets to the funded debt less one. The net assets in this case will approximately equal the fixed assets unless

a very high current ratio is maintained. The valuation of the assets, however, is determined by the market value of the stock rather than by the cost value of the assets.

The "stock equity test," so called when derived from the market value of the stock rather than from the cost value of the assets, has minimum percentage rates as determined for investment purposes for different classes of securities. The approximate percentages of bonded debt to the market value of the stock are as follows:²⁵

Public Utilities	50% of the bonded debt
Railroads	66 2/3% of the bonded debt
Industrials	100% of the bonded debt

When stated in terms of the net assets, the assets should be the following percentages of the bonded debt:

Public Utilities	150% of the bonded debt
Railroads	166 2/3% of the bonded debt
Industrials	200% of the bonded debt

Ratio of Net Worth to Total Liabilities. The ratio of net worth to total liabilities expresses the relationship between the equity of the stockholders and the equity of creditors. This ratio may increase from year to year through retention of earnings, additional sale of capital stock, or through reduction of liabilities. A very small percentage ordinarily would mean that creditors, rather than stockholders, are financing the business.

²⁵See Benjamin Graham and David L. Dodd, Security Analysis, Second Edition, McGraw-Hill Book Company, Inc., New York, 1940, p. 156, for further details on the "stock equity" test. The ratios above are arbitrarily established and are used by Graham and Dodd for investment purposes only for a specific type of analysis--"fixed value investments." The use by an accountant of this test for management purposes would probably be limited to financial management.

Book Value of Common Stock. (a) Including intangibles. To determine the book value of the common stock when intangibles are included in the assets, divide the stockholders' interest--Common Stock, Surplus, and Reserves--by the number of shares outstanding. Although the book value of stock is not a very efficient index of the value of stock, the relationship between tangible net worth and intangible net worth may be discovered also by finding the book value of the stock when the intangible assets is excluded.

(b) Excluding Intangibles. Deduct all items which have no present tangible value such as goodwill, patents, and copyrights from the stockholders' interest and divide this by the outstanding shares of stock.

Finding the book value of stock becomes confusing when more than one type of stock is outstanding. Preferred stock, however, has a value equal to the amount in the books. Subtract the book value of the preferred stock before determining the net worth of the common stock.

Complications also arise in determining the book value of preferred and common stock when the preferred stock is either cumulative or participating, or such items as passed dividends, call prices, and liquidation value are considered. The following illustration of an assumed company shows the computations of the book values of both common and preferred stock when the preferred stock is cumulative and participating, and the dividends on the preferred is one year in arrears, while the current dividend has not been passed on either the preferred or the common stock. The Net Worth

of the XYZ Manufacturing Company on December 31, 1943, is as follows:

XYZ Manufacturing Company

Net Worth

December 31, 1943

Common Stock, 3,000 shares, par value \$50 per share	\$150,000
Preferred Stock, 6%, 1,000 shares, par value \$100 per share	100,000
Surplus	<u>75,000</u>
Total Net Worth	\$ <u><u>325,000</u></u>

Surplus	\$75,000
---------	----------

Dividends in arrears on Preferred Stock (6% x \$100,000)	\$6,000
---	---------

Dividends for current year on Preferred Stock (6% x \$100,000)	6,000
--	-------

Dividends for current year on Common Stock (6% x \$150,000)	<u>9,000</u>
---	--------------

Total reserved for dividends	\$ <u><u>21,000</u></u>
------------------------------	-------------------------

Balance available for dividends	<u><u>54,000</u></u>
---------------------------------	----------------------

Balance Available for Dividends:

Available for dividends to Common Stock ($\frac{150,000}{250,000} \times \$54,000$)	\$32,400
---	----------

Available for dividends to Preferred Stock ($\frac{100,000}{250,000} \times \$54,000$)	<u>21,600</u>
--	---------------

\$54,000

Book Value of Preferred Stock:

Preferred Stock	\$100,000	
Surplus due on dividends	12,000	
Surplus available for participation in dividends	<u>21,600</u>	
Total Book Value of Preferred Stock		<u>\$133,600</u>
Book Value per share of Preferred Stock:		
(\$133,600 ÷ 1,000)		<u>\$ 133.60</u>

Book Value of Common Stock:

Common Stock	\$150,000	
Dividends allowed for current year	9,000	
Surplus available for dividends	<u>32,400</u>	
Total Book Value of Common Stock		<u>\$191,400</u>
Book Value per share of Common Stock:		
(\$191,400 ÷ 1,500)		<u>\$127.60</u>

Net Worth Represented by Total Current Liabilities. Divide the net worth into the total of the current liabilities. The percentage obtained shows the current debts to the equities of the stockholders. By subtracting this ratio from the ratio of net worth to total liabilities, the ratio between net worth and fixed liabilities may be obtained.

Fixed Assets to Tangible Net Worth. This ratio has not been extensively recognized by operating management, but it helps to determine when excessive investment in fixed assets relative to

the tangible net worth of the company has occurred. Since fixed assets cannot usually be turned into any type of operating assets in a short time, the ratio between the fixed assets and the net worth after deduction of intangibles presents a percentage which shows whether or not the company has too high a proportion of its net worth invested in the fixed assets.²⁶

Net Working Capital Represented by Funded Debt. Foulke makes this statement:

The examination of thousands of balance sheets in all lines of activity in good times and poor have led to the one conclusion that rarely, if ever, should the aggregate of funded liabilities exceed the net working capital. Such a relationship is invariably top-heavy. With all of its own capital tied up in non-liquid assets, the business enterprise is then currently operated from day to day on borrowed capital. Interest and amortization become a burden often too great to be carried in a world of fluctuation sales and constantly varying gross margins of profit.²⁷

To derive the ratio of net working capital to Funded Debt, divide the difference between the current assets and the current liabilities by the total of the bonded indebtedness. As this ratio is one of the newer types of ratios, very little information about its usefulness can be found. Foulke, of Dun and Bradstreet, however, claims it as one of three important capital ratios employed in the analysis of manufacturing, retail, and wholesale establishments.²⁸

²⁶Roy A. Foulke, Behind the Scenes of Business, Revised Edition, Dun & Bradstreet, Inc., New York, 1937, pp. 35-48 has an interesting discussion about the use of this ratio.

²⁷Ibid., p. 47.

²⁸Ibid., pp. 35-58.

Analysis of Items on the Profit and Loss Statement.

Percentage of each item to sales. As in the analysis of the balance sheets, where each individual asset, liability, and capital is compared to totals of that type of asset, liability, or proprietorship, so in the analysis of the profit and loss statement the net sales represents the figure with which comparisons are being made, or the one-hundred per cent. The following profit and loss statement of the Jones Manufacturing Company, Illustration II, illustrates comparisons of each item to net sales, and also the percentage of each item to the total for the group of items. The Cost of Goods Manufactured is analyzed separately in Schedule I. (Illustration III).

The following are the important percentages derived:

- I. Per cent of each item to net sales.
- II. Per cent of each class of item to net sales.
- III. Per cent of each item on the Statement of Cost of Goods Manufactured to the total cost of goods manufactured.
- IV. Per cent of individual manufacturing expenses to total manufacturing expenses.
- V. Per cent of individual selling expenses to total selling expenses.
- VI. Per cent of individual general expenses to total general expenses.
- VII. Per cent of individual other income and other expenses to total other income and other expenses.

Illustration II
JONES MANUFACTURING COMPANY
Statement of Profit & Loss
For Year Ending December 31, 1943

<u>Income from Sales:</u>			
Gross Sales	\$122,000.00		101.7%
Sales Return & Allowance	<u>2,000.00</u>		<u>1.7</u>
Net Sales	120,000.00		100.0
Cost of Goods Sold:			
Inventory Finish Goods 1/1/43	\$ 3,500.00		
Cost of Goods Mfg. Schedule I	<u>85,000.00</u>		
Goods Available for Sale	88,500.00		
Inventory Finish Goods 12/31/43	<u>4,000.00</u>		
Cost of Goods Sold	84,500.00		70.4
Gross Profit on Sales	<u>35,500.00</u>		<u>29.6</u>
<u>Selling Expenses:</u>			
Insurance	50.00	.3%	.0%
Lease	<u>100.00</u>	.5	.1
Advertising	5,000.00	24.8	4.2
Salesman's Salaries	<u>7,000.00</u>	34.7	5.8
Salesman's Traveling Expense	5,000.00	24.8	4.2
Misc. Selling Expenses	<u>3,000.00</u>	14.9	<u>2.5</u>
Total Selling Expenses	20,150.00	100.0	16.8
Net Profit on Sales	<u>15,350.00</u>		<u>12.8</u>

General Expenses:

Office Salaries	4,500.00	52.0	3.8
Stationery & Printing	1,500.00	17.3	1.2
Office Supplies	500.00	5.8	.4
Telephone & Telegraph	400.00	4.6	.3
Misc. General Expenses	750.00	8.7	.6
Bad Debts	800.00	9.3	.7
Depreciation Office Equipment	200.00	2.3	.2
Total General Expenses		100.0	<u>7.2</u>
Net Profit on Operation			<u>5.6</u>

Other Income - Expenses:

Other Expenses			
Bond Interest	\$1,200.00	48.0	1.0
Other Interest Cost	300.00	12.0	.3
Sales Discount	1,000.00	40.0	.8
Total Other Expenses		100.0	<u>2.1</u>
Other Income			
Purchase Discount	600.00	75.0	.5
Interest Earned	200.00	25.0	.2
Net Other Expenses		100.0	<u>.7</u>
Net Profit before Income Tax			<u>1.4</u>
Provision for Income Tax			4.2
Net Profit to Surplus			<u>.8</u>
			<u>3.4</u>
			<u>1,700.00</u>
			<u>5,000.00</u>
			<u>1,000.00</u>
			<u>4,000.00</u>

Schedule 12

	Percentage of Mfg. Cost
Goods in Process Inventory 1/1/43	
Raw Materials:	
Inventory, 1/1/43	
Purchases	\$3,000.00
Less Purchase Returns & Allowance	
Net Purchases	<u>30,000.00</u>
Total	<u>33,000.00</u>
Less Inventory 12/31/43	
Total Materials	<u>2,000.00</u>
Direct Labor	
Manufacturing Expense	
Indirect Labor	7,000.00
Heat, Lights & Power	4,500.00
Repair to Building & Machinery	300.00
Insurance	450.00
Loan	500.00
Factory Supplies	1,000.00
Misc. Factory Expense	1,500.00
Depreciation - Factory Building	1,500.00
Depreciation - Machinery	2,000.00
Depreciation - Tools	<u>500.00</u>
Total Manufacturing Expenses	<u>100.0</u>
Total Manufacturing Cost	<u>21.6</u>
Less Goods in Process Inv. 1/1/43	<u>100.0</u>
Cost of Goods Manufactured	<u>4.8</u>
	<u>95.2</u>

Operating Ratio. The ratio between the total operating expenses and the net sales is the operating ratio. In the total operating expenses are included both the expenses of doing business as well as the cost of goods sold. Obviously, this ratio subtracted from 100% would give the net profit on operations in terms of percentages.

At times, items which cannot be controlled by management, such as depreciation and taxes, are left out when computing the operating ratio, but the more common usage seems to be to include all of these expenses.

Earnings to Fixed Charges. Especially in companies which have a large amount of fixed indebtedness, does the ratio of earnings to fixed charges play an important part. As no company is likely to continue in business very long if it is unable to pay interest charges on the bonds when they fall due, then it is important that the earnings adequately cover the fixed charges. The ratio of earnings to fixed charges need not be as great for utilities and railroads as for industrials, since the income of utilities does not fluctuate as greatly. Graham and Dodd use this ratio as one of the important ratios with which they analyze securities having a "fixed value such as bonds and some classes of preferred stock." The ratio is computed from a seven-year average of earnings and must be at least two to one for railroad bonds, one and three-fourths to one for

public utility bonds, and three to one for industrial bonds.²⁹

Analysis of Items on Both the Balance Sheet and Profit and Loss Statement.

Surplus Net Profits to Net Worth. The following is quoted from

Bliss:

The surplus net profits earned on the net worth is the real measure of the earning power of a business from its stockholder's point of view. It is the measure of the commercial success of a business. This relationship is commonly stated as the percentage of profits earned annually on the stockholders' investment. It is entirely similar to the return an individual or partner figures on his investment in a business. This return should be figured on the basis of the annual earnings remaining at the disposition of the stockholders in relation to the stockholders' equity in the business.

The relation of surplus net profits to net worth--the percentage earned on stockholders' investment--is the final summing up of all other relationships and measures of business efficiency. It results from, and includes, all other relationships, earnings and expenses ratios, turnovers, etc. Favorable or unfavorable gross margins, expenses, operating earnings, turnovers, etc., are all included in and affect the final net return on the stockholders' investment. It is, in the last analysis, the measure of commercial success obtained in the management of the affairs of a business in all three functions--merchandising, operating, and financial.³⁰

To compute this ratio, all types of capital accounts--capital stock, surplus, and surplus reserves--should be included in net worth. The surplus net profits are those profits which are to be

²⁹Benjamin Graham and David L. Dodd, op. cit., p. 156.

³⁰James H. Bliss, Financial and Operating Ratios in Management, The Ronald Press Company, New York, 1923, p. 57.

transferred to surplus. The ratio will vary, depending upon the type of industry and the age of the industry. Of course, this ratio is more important when compared with ratios for previous years than it is as a single ratio.

Inventories Turnover. The meaning of the word "turnover" in accounting has been fairly well standardized. It means the number of times the average inventory is sold each year. To determine the number of times the inventory is sold each year, divide the inventory into the cost of goods sold for the year. The inventory may be the opening inventory or an average of the opening and closing inventories; and when monthly inventories are kept, it is better to use an average of the monthly inventories, as variations of amounts due to seasonal changes are then given consideration.

When the percentage rates of profit on sales are the same, the greater the turnover, the greater the profit. Obviously, the greater number of turnovers of inventory each year, the greater the amount of profit obtained from the same investment. If the average inventory is \$10,000 and the turnover is ten times, more goods would be sold than if the turnover is five times.

In a manufacturing business, turnover refers to finished goods unless otherwise stated. Turnover may also refer to an average of all types of inventories, but this is uncommon. From the above illustration, of the Jones Manufacturing Company, the turnover of finished goods is 22.5 times, showing that if the inventory represents the average, it is sold out approximately every two weeks.

Turnover of Receivables. To calculate the rate of turnover of receivables, divide the net sales for the year by the average of the totals of notes and accounts receivable. It is better to use the average of monthly balances of accounts and notes receivables, but it is also possible to compute the ratio from the amount of notes and accounts receivables on the balance sheet. Assuming that the balance of notes and accounts of the Jones Manufacturing Company is equivalent to the average amounts, then the total of these two, \$17,850, divided into the net sales, \$120,000, gives a turnover of 6.7 times. When this is divided into 100%, the percentage rate of turnover is 14.9%. To determine the number of days of average daily sales included in the receivables, multiply the 14.9% by the number of days in the year. Assuming 300 business days in the year, and multiplying by 14.9%, approximately 45 days' sales is included in the notes and accounts receivables.

Percentage of Accounts Receivable Paid within Discount Period.

To determine the approximate age of the accounts, the following method of analysis is reasonably accurate. In the Jones Manufacturing Company Statement the sales amount to \$120,000. If the discount rate were 2/10, n/30, the total possible discount would be \$2,400. As the sales discount is \$1,000, 41 2/3% of the customers took advantage of the discount. As the total sales are \$120,000, the average monthly sales are \$10,000. On the average, 41 2/3% of the sales are paid in ten days, or \$4,167, leaving a balance of \$5,833 not paid within the ten days. By dividing the

total of the accounts and notes receivable which have not been discounted, \$17,850, by \$5,833, the amount not paid within the discount period, the total months that the accounts are on the books is derived, or 3.1 months.

Since this analysis is in terms of the average month, the accountant may be able to present more favorable information to management, such as the accounts receivable being due to large December's sales, which would tend to make the number of months' bills which are outstanding appear higher.

The accountant has access to the books upon which he works, so a better method of analyzing receivables is to list each customer's account and distribute the amount in columns indicating the time period that the account is past due. The analysis of the turnover of receivables and aging of the accounts through the discount taken is of use mainly when access to the accounts themselves is not available.

Turnover of Payables. Analysis similar to that of the turnover of inventories and the turnover of receivables may be made of the purchases and the accounts payable. As notes may be made for items not related to purchases, notes payable are not usually included in this type of analysis.

To find the percentage of purchases unpaid, divide the net purchases into the accounts payable. To find the approximate days the purchases remain unpaid, multiply the derived percentages by the number of days in the year, 365. Referring to the Jones Ham-

facturing Company's Balance Sheet and Profit and Loss Statement, the accounts payable, \$9,000, divided by the purchases, \$30,000, gives 30%, and when multiplied by 365 days gives 110 days' purchases remaining unpaid.

Percentages of Accounts Payable Paid Within the Discount Period.

To determine the percentage of accounts paid within the discount period, divide the total purchase discounts taken by the total possible discounts. To calculate the total possible discounts, multiply the prevailing discount rate, in the type of industry being analyzed, by the total net purchases. The analysis of accounts payable is similar to that of accounts receivable in regard to determining the turnover and the percentage of accounts paid within the discount period.

Since the accountant usually has access to the accounts payable records, it is much more accurate to age the accounts by listing in columns, by time periods, each account for which payment has not been made. The above analysis, both for accounts receivable and accounts payable, is important when access to the individual accounts is not readily obtainable.

Turnover of Working Capital. The turnover of working capital is determined by dividing the average net current assets--current assets less current liabilities--into the sales. Of course, the more times the net working capital of business turns over, the better chance it has of success as compared with a similar business with a lower turnover. As in all turnover ratios, different indus-

tries have different ratios and what is appropriate for one industry may not be related to that of another.

Sales to Net Fixed Tangible Assets. This ratio shows turnover of fixed assets, and is computed by dividing the sales by the total fixed assets. Since the amount of fixed assets varies, it is usually better to use an average of fixed assets if possible. This ratio measures the relationship of sales to the investment in fixed assets and sometimes is computed on only the plant and equipment.

Sales to Tangible Net Worth. By dividing the sales by the net worth, after deduction of intangible assets, a ratio is derived which shows the turnover of net worth.

Net Profit on Net Working Capital. This ratio is sometimes valuable, especially in firms which have a high working capital ratio. To compute the percentage of net profit on net working capital, divide surplus net profits by the net working capital.

Miscellaneous Ratio and Percentage Analysis.

The use of percentages and ratios in the analysis of statements may be carried to almost any degree. There are, at times, uses which have not been included in the previous discussion, but which are more valuable than many of those already explained. For example, a person may desire to know if the Notes Receivable account at the end of the year is representative of the entire year. If the prevailing rate of interest is known, the amount of average notes receivable may be derived from the interest earned account.

To illustrate, in case of the Jones Manufacturing Company, the interest earned is \$200, and if the prevailing rate of interest is 4%, the average amount of notes receivable is \$5,000 ($\$200 \div .04$), indicating that the notes receivable of the Jones Manufacturing Company has been greater throughout the year than when the statement is made.

With the same analysis on interest cost and notes payable, and the same percentage rate, when 4% is equal to the interest cost of \$300, 100% equals \$7,500 ($\$300 \div .04$). Notes receivable are discounted, however, thus increasing the interest cost, and would have to be included in the notes payable to determine the amount on hand.

Any item on the profit and loss statement which is related to any item on the balance sheet may be compared in terms of percentages. Rates of depreciation, rates of insurance, rates of bad debts, and others may all be roughly approximated by percentages.

The accounting department may make ratio analyses for each of the operating departments such as, in case of the credit and collection department, the percentage of uncollectible accounts to sales; in case of the buying department, buying expenses to purchases; and, in case of the factory, ratios of inventory to cost of goods manufactured.

For ready reference, the above ratios and percentages are condensed into the following table, Table I. No attempt has been made to include ratios which can be used to analyze comparative statements.

Table I

TABLE OF MOST COMMONLY USED RATIOS AND PERCENTAGES SHOWING METHODS OF COMPUTATION AND SIGNIFICANCE

<u>RATIOS</u>	<u>HOW COMPUTED</u>	<u>SIGNIFICANCE</u>
I. Balance Sheet Analysis		
A. Relationship between Individual item or sections to totals		
a. Percent of each reserve to the related asset account	Divide reserve by book value of asset	Shows percent of asset represented by reserve
b. Percent of each current asset to total current assets	Divide each individual asset by total of current assets	Shows relationship of individual current asset to total current asset
c. Percent of each fixed asset to total fixed assets	Divide net book value of individual asset by total of fixed assets	Shows relationship of individual fixed asset to total of fixed asset.
d. Percent of each individual asset in investments, deferred charge, intangible or other assets to totals of classes	Divide amount of individual asset by total of that class of assets	Shows relationship of individual asset to total
e. Percent of each class of assets to total assets	Divide total assets into each group. Total equals 100%.	Shows relationship of sections to total assets
f. Percent of individual current liabilities to total current liabilities	Divide total current liabilities into individual current liabilities.	Shows relationship of individual current liabilities to liabilities
g. Percent of individual fixed liabilities to total fixed liabilities	Divide individual fixed liabilities by total of fixed liabilities	Shows relationship of individual current liabilities to fixed liabilities
h. Percent of each class of liabilities and capital to total liabilities and capital	Divide total liabilities and capital into each class of liabilities capital or surplus	Shows relationship of each section to total
B. Current Ratio	Divide total current assets by total current liabilities	Shows current position of company

RATIOS

HOW COMPUTED

SIGNIFICANCE

C. Cash to Bank Loan	Cash divided by Bank Loan or Notes Payable	Shows cash position in regard to bank loans or notes
D. Cash to Current Liabilities	Divide cash by total current liabilities	Shows ease of liquidity of current liabilities
E. Quick Ratio	Divide current liabilities into cash and receivables	Shows if company can meet current liabilities without inventories
F. Net Current Assets invested in inventories	Net current assets - current liabilities - current assets, divide by inventory	Shows over-expansion of inventories
G. Fixed Assets to Fixed Liabilities	(1) Divide total fixed assets to total fixed liabilities, (2) Divide market value of stock by bonds and add 1	Determines proportion of fixed assets related to funded debt
H. Net Worth to Total Liabilities	Divide total net worth by total liabilities	Shows relationship between equity of stockholders and creditors
I. Book Value of Common Stock	Divide either total net with or net worth less intangibles by total number of shares of stock outstanding	Shows value on book of outstanding stock
J. Net Worth represented by total current liabilities	Divide net worth by total current liabilities	Shows relationship between equity of stockholders and current creditors
K. Fixed Assets to Tangible net worth	Divide total fixed assets by total net worth less intangibles	Shows whether too high a proportion of net within invested in fixed assets
L. Net Working Capital represented by Funded Debt	Divide current assets minus current liabilities of funded debt	Shows if business is operated in fixed assets

RATIOS

HOW COMPUTED

SIGNIFICANCE

II. Profit and Loss Analysis

A. Percentage of each item to net sales

1. Percent of each item to net sales
2. Percent of each class of items to net sales
3. Percent of each item on the statement of cost of goods mfg. to the total cost of goods mfg.
4. Percent of individual mfg. expenses to total mfg. expenses
5. Percent of individual selling expense to total selling expenses
6. Percent of individual general expense to total general expenses

Divide sales into each individual item on P & L Statement
Divide sales into total of major divisions on P & L Statement
Divide cost of goods mfg. into each item
Divide individual expenses by total mfg. expenses
Divide individual expense by total selling expenses

Shows relation of each item to sales
Relations of major classes to sales
Relation of individual item to total
Shows relation of individual expense to total mfg. expenses
Relation of individual expenses

The percentage of the individual item to the total may be taken for any additional groups on the statement of profit and loss

B. Operating Ratio

Divide total operating expenses and cost of sales by sales
Earnings divided by Fixed Interest charges

Tests efficiency of operation
Shows bondholder's security of principal and interest

C. Earnings to Fixed Charges

RATIOS

III. Items of Balance Sheet and Profit and Loss Statements

- A. Surplus Net Profits to Net Worth
- B. Turnover of inventories
- C. Turnover of Receivables
- D. Percentage of Accounts Receivable paid in other discount period
- E. Turnover of Payables
- F. Percentage of Accounts payable paid within discount period
- G. Turnover of working capital
- H. Sales to Net Fixed Tangible Assets
- I. Sales to Tangible Net Worth
- J. Net Profit on Net Working Capital

HOW COMPUTED

- Net profit after income tax divided by total net worth
- Sales divided by average inventories
- Days in year divided by ratio between sales and total of notes and accounts receivable
- Sales discount divided by total possible discount.
(Rate of discount times account sales.)
- Days in year divided by ratio between accounts payable and purchases
- Purchase discount divided by total possible discount.
(Discount sale times purchases.)
- Net working capital divided by sales
- Fixed assets divided by sales
- Sales divided by net worth after deduction of intangibles
- Net profits divided by working capital

SIGNIFICANCE

- Ratio of earning to shareholder's investment
- Over investment in inventories and selling efficiency
- Tests credit and collection policy
- Tests collection policy
- Tests financial management policy
- Tests financial management ability
- Tests Selling ability
- Shows relationship of sales to fixed investment
- Tests managerial efficiency in asset investment
- Managerial guide

CHAPTER V

GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED

Averages and Dispersion

Meaning and Characteristics of Averages

If it were necessary for the accountant to prepare reports on all of the numerical data which is gathered by the company, the reports would be numerous and much of the information would be lost because of detail. Individual sales are not reported, but the total sales are; individual wages are not reported, but the total wages for departments are; individual costs of production are seldom reported, but total costs and average costs are.

One of the most suitable of the methods of analyzing numerical data with which the accountant deals, in order to eliminate much of the detail, is through the use of averages. In dealing with averages, an attempt is made to represent all of the individual figures by one number which is typical of each of the items making up the total. Individual sales may range from ten cents to one hundred dollars, but the figure which is typical of all the sales--the average--may be eight dollars and sixty-seven cents. Weekly wages for pipe-fitters in a manufacturing company may vary from thirty-five dollars to

twenty-five dollars, but one figure which is representative of all of the weekly wages--the average--may be sixty-five dollars. If total costs of production of a manufactured device are seventy-five thousand dollars, and one hundred and fifty thousand units are produced, the individual cost per unit--the average cost--is fifty cents.

As the average is a figure which is arbitrarily accepted as being typical of all of the numbers represented, it may be one of the variables represented or it may be some intermediate value which is not actually one of the data. The average, however, must of necessity be the same type of information as the original data; e.g., if the original data are percentages, the average must be a percentage; if the original data are wage dollars, the average must be wage dollars.

Various types of averages have been developed, some of which are more important for a special condition than others; however, the three most common types of averages are the arithmetic mean, the median, and the mode. For special purposes, the geometric mean and the harmonic mean are sometimes employed. As each type of average has its special purpose, it is sometimes difficult to determine the average which will best represent the mass of data. Theoretical attempts have been made to determine one average which is best for all purposes, but at the present time there is no one measure of average relationship which is best suited for all purposes. The arithmetic mean, however, most nearly approaches the

desirabilities for an average for widespread or general use.³¹

Arithmetic Mean

Simple arithmetic mean. The simple arithmetic mean is found by dividing the sum of all of the items to be averaged by the number of the items. For example, if the wages per hour of five employees are 50¢, 75¢, 60¢, 40¢, and 60¢, the average wage is determined by dividing the sum, \$2.85, by the number 5, which gives 57¢. This one number, while not the same as any of the other numbers, represents and is typical of all five. It may be noticed that it makes no difference in which order the figures are arranged to determine the sum.

If the sum of any given numbers is known, then the arithmetic mean may be determined, whether the individual figures are available or not, as all that is necessary is to divide the sum by the number. That is, if the daily wages of thirty men total \$330.00, then the average wage per man is $\frac{\$330}{30}$, or \$11.00.

At times it is difficult to analyze large masses of numerical data until it has been classified into smaller groups. The Ford Motor Company would have a hard time collecting and analyzing the

³¹See G. Udny Yule and H. G. Kendall, An Introduction to the Theory of Statistics, Charles Griffin & Company, Limited, London, 1940, pp. 113-4 for "Desiderata for a Satisfactory Average."

wage and payroll information unless it is further classified into a frequency distribution. For example, how many of the employees in the plant earn between three and five dollars a day? What is the average wage? To illustrate the computation of the arithmetic mean when group data is available, the following method, Illustration IV, is used, assuming the condition stated. The following method is sometimes called the "short method of computing the mean," because much time is saved through using it rather than other methods.

It may be noticed that when class intervals are used, the midpoint of the class interval is assumed to be the arithmetic mean of the values in that class. By multiplying the midpoint of the class interval by the frequency of the class interval, the sum of the values in each class interval is determined. By taking the sum of the frequencies times the midpoint, the total of all the values is found; and by dividing the number of cases, the mean is calculated.

An arbitrary midvalue, usually the one in the class interval having the greatest number of frequencies, is chosen as the assumed mean. Deviations in terms of class intervals (d') are taken above and below the assumed mean and multiplied by the frequencies (f) of that class interval. The algebraic sum of the products of the frequencies times the deviation ($\sum fd'$) when divided by the number of frequencies (n) gives the correction factor in terms of class intervals. By multiplying the correction factor by the value of

Illustration IV
Jones Manufacturing Company
Daily Pay for Employees
Week ending July 31, 1943

<u>Daily Earnings in Dollars</u>	<u>Number (f)</u>	<u>(d')</u>	<u>(fd')</u>
1.00 — 1.49	1	-6	-6
1.50 — 1.99	2	-5	-10
2.00 — 2.49	6	-4	-24
2.50 — 2.99	15	-3	-45
3.00 — 3.49	22	-2	-44
3.50 — 3.99	40	-1	-40
4.00 — 4.49	55	0	0
4.50 — 4.99	23	+1	+23
5.00 — 5.49	14	+2	+28
5.50 — 5.99	9	+3	+27
6.00 — 6.49	3	+4	+12
6.50 — 6.99	4	+5	+20
7.00 — 7.49	2	+6	+12
7.50 — 8.00	1	+7	+7
8.00 — 8.49	0	+8	0
8.50 — 9.00	1	+9	+9
	<u>198</u>		<u>+138</u>

$$\bar{X} = A + C$$

$$\bar{X} = A + \frac{\sum fd'}{n}$$

$$\bar{X} = \$4.245 + \frac{(+138)}{198} \times .50$$

$$\bar{X} = \$4.245 + \frac{\$15.50}{198}$$

$$\bar{X} = \$4.245 + .078$$

$$\bar{X} = \$4.167$$

A = Arbitrary midpoint chosen as mean

\bar{X} = Mean

f = Frequency

d' = Deviation from assumed mean in terms of class interval

i = Class interval

Σ = Sigma, the sum of

n = Number of frequencies

c = Correction factor

the class interval (i), the value necessary to add to the assumed mean to make it equal to the true mean is derived.

It makes no difference which midpoint is chosen as the arbitrary origin, as the value of the mean remains the same. The procedure in computing the arithmetic mean by using deviations from an assumed mean is based on the principle that the algebraic sum of the deviations of the various values from the mean equals zero. As the sum of the deviations from the mean must equal zero, then if the sum of the deviations from an assumed mean is greater or less than zero, all that is necessary to find the correct mean is to add the relative amount that is above or below the assumed mean. In the above case, it is necessary to add a minus \$15.50, divided by the total number, 198, giving a net addition of $-\$.078$ to the assumed mean.

Weighted Arithmetic Mean. When certain variables are considered more important than others, and have more influence in determining a value representative of a series of figures, weighting is sometimes employed. To illustrate one of the common uses of the weighted arithmetic mean in accounting, the distribution of profits by the average capital is considered. If the profit for the year for Jones and Smith, Partners, is \$5,000 and the capital accounts are as follows, the divisions of the profit is as shown.

A. B. Jones, Capital				T. E. Smith, Capital			
May 1	5,000	Jan. 1	10,000	June 1	1,000	Jan. 1	15,000
		July 1	5,000	Sept. 1	2,000		

A. B. Jones, Capital							
				Weight			
From January 1 to May 1	4 months	\$10,000			\$40,000	month dollars	
From May 1 to July 1	2 months	5,000			10,000	month dollars	
From July 1 to Dec. 31	6 months	10,000			60,000	month dollars	
Total	12 months				\$110,000	month dollars	
Average month dollars = \$9,175.							

T. E. Smith, Capital							
From January 1 to June 1	5 months	\$15,000			\$75,000	month dollars	
From June 1 to Sept. 1	3 months	14,000			42,000	month dollars	
From Sept. 1 to Dec. 31	4 months	12,000			48,000	month dollars	
Total	12 months				\$165,000	month dollars	
Average month dollars = \$13,750.							
Total Average Month Dollars is \$22,925.							

The distribution of profit

$$\text{A. B. Jones: } \frac{9,175}{22,925} \times \$5,000 = \$2,000$$

$$\text{T. E. Smith: } \frac{13,750}{22,925} \times \$5,000 = \$3,000$$

Profit for year \$5,000

As the same ratio will be found if total month dollars is used rather than average month dollars, it is seldom necessary to find average month dollars. Add together the month dollars for A. B. Jones, \$110,000, and that for T. E. Smith, \$165,000, and then take the ratio of each to the total for each partner and the same distribution will result.

Moving Averages. Moving averages are often used in the computation of seasonal indexes and in the analysis of data which have additional units added, such as periodic labor costs and periodic

material costs. Curtis and Cooper say about the moving average:

"Moving averages are a series of simple averages of statistics applicable to groups of an equal number of time units, each successive group excluding the first time unit of the preceding group and including the unit immediately following those of the preceding group."³² The moving average tends to compare data which are more closely related by eliminating information from old time periods and adding new information. The following illustration shows the average sales for each three months period from January 1 to July 31, 1943.

Sales X Company
Jan. 1-July 31, 1943

Jan.	\$25,000	Total Jan. 1 to Mar. 31	\$78,000
Feb.	23,000	Average 1st three months	
Mar.	30,000	$\$78,000 \div 3 = \$26,000$	
Apr.	31,000	Add April Sales	<u>31,000</u>
May	29,000		109,000
June	24,000	Less Jan. Sales	<u>25,000</u>
July	22,000	Total Feb. 1 to Apr. 30	84,000
		Average	
		$\$84,000 \div 3 = \$28,000$	
		Second three month period	
		Add May Sales	<u>29,000</u>
			113,000
		Less Feb. Sales	<u>23,000</u>
		Total Mar. 1 to May 31	90,000
		Average third three month period	
		$\$90,000 \div 3 = \$30,000$	

The Progressive Average. The progressive average is the arithmetic mean of data, when additional units are successively added.

³²Curtis and Cooper, op. cit., p. 108.

The new unit is added to the old total and divided by the total number of units included in the study. That is, the average sales for a company for the past three years may be \$1,000 per month, or a total sales of \$36,000. To compute the progressive average, add the present month's sales, \$1,185, to the total sales and divide by 37 which gives the progressive average of \$1,005.

Characteristics of Arithmetic Mean. The arithmetic mean is probably employed for more purposes than any other type of average. However, it has some limitations as well as benefits. Stockton summarizes the chief characteristics of the arithmetic mean as follows:

1. The value of the arithmetic mean is based on all the observations, and thus is affected by all the values of the variable. This may result in giving certain extreme values too much influence.
2. The arithmetic mean is rigidly defined and is always determinate if the individual values of the variable are available.
3. The arithmetic mean may be calculated if the individual items are known; if the total value and the number of items are known; or if a frequency distribution is available from which it is possible to estimate closely the average value of the items falling in each class.
4. The arithmetic mean lends itself to further algebraic manipulation.³³

The Median

Although the arithmetic mean is probably employed more often

³³John R. Stockton, An Introduction to Business Statistics, D. C. Heath and Company, Boston, 1938, p. 117.

than any other type of average, the results derived from using the arithmetic mean at times are quite misleading. For instance, if there are ten employees of a company, and their yearly wages are:

\$2,000	\$3,600
3,000	2,400
2,000	2,000
2,500	2,400
2,500	12,000

then the arithmetic mean of the employees is \$3,440. In the above figures, only two of the ten employees' salaries are above the arithmetic mean, while eight are below the mean salary. Does this mean that \$3,440 is representative of the ten employees? Obviously it is not, if a figure which represents the salaries of all ten men is desired.

The median is a type of average which does not take into consideration the extremes which cause an arithmetic mean to be unduly biased, as it is not based upon the mathematical relationship which exists between the numbers. The median of a group of numbers is the value of the item occupying the middle position of a group when arranged from smallest to largest or from largest to smallest (an array).

The middle position of a long list of items arranged in an array may be easily determined by counting from the first item to the middle item $(n + 1) \div 2$, or by counting successive spaces to the middle item $(n \div 2)$. As there is no middle item when the group contains an even number, the mean of the two middle items is usually taken as the median.

When items are grouped in class intervals rather than by individual items, the interval in which the median will be found is easy to determine by finding the middle frequency and using the midpoint of the class interval of that frequency. However, to determine more accurately the median within the class interval, the proportionate distance of the middle item between the lower class limit and the upper class limit is taken.

Characteristics of the Median. The following list from Stockton adequately describes the median's chief characteristics:

1. The median is affected by the position of each item in the series, but not by the value of each item. This means that extreme deviations from the central part of the distribution affect the median less than the arithmetic mean.
2. The median may be located when the data are incomplete, e.g., if the values of the variable at the extremes are unknown, but their general location is known.
3. The median is, strictly speaking, indeterminate for an even number of cases, although by general agreement it is the mean of the two central values of the variable. When several items in the center of the distribution are the same size the median may be indeterminate to a slight degree.
4. The median does not lend itself to algebraic treatment in as satisfactory a manner as the arithmetic mean (or the geometric mean).³⁴

The Mode

The mode is the one value of a group of items which occurs most

³⁴Ibid., p. 117.

frequently, or is the common value. One encounters the use of the mode as an average when considering the average family or average income--the family or income which is most often encountered. In accounting, while not often used, the mode may be employed as the average for typical sales, production, wages, material, depreciation rates, and expenses. The greatest disadvantage of the mode from the accounting viewpoint is that the total cannot be calculated from the mode even though the number of cases is known. When the modal average is determined, it is only a representative figure and cannot be further algebraically manipulated.

The mode is difficult to determine from ungrouped data, but an approximate mode can be determined easily from grouped data by taking the midpoint of the class interval with the greatest frequency. A more refined method of calculating the mode may be accomplished by interpolation within the modal class and by weighting the interpolation with the frequencies of the class intervals immediately preceding and succeeding the modal class.³⁵

The mode may also be determined graphically by making a histogram³⁶ of the data and then drawing lines from the upper corners of the rectangle representing the modal class diagonally to the upper corners of the adjacent rectangles. Where the diagonal lines in-

³⁵George R. Davies and Dale Yoder, Business Statistics, John Wiley and Sons, Inc., New York, 1937, pp. 93-4 for method of computation.

³⁶See p. 163 for discussion of histograms.

tersect, a point drawn perpendicular to the X axis will represent the modal ordinate and when done will agree with the mode as computed by interpolation.³⁷

Similarly to the mean and the median, Stockton lists the principal characteristics of the mode:

1. The value of the mode is determined by the items at the point of greatest concentration, and is not affected by the remaining values of the variable.

2. Since the mode is the point of greatest concentration, it is typical of the distribution. When more than one mode exists, it probably means the distribution should be broken into more than one distribution to secure homogeneity.

3. The true mode is difficult to compute, although an approximate value is easily found.³⁸

The Harmonic Mean

The harmonic mean is not as well known an average as other types, but it may have important functions when dealing with weighted averages of prices and quantities. Davies and Yoder give the following explanation of the harmonic mean:

The harmonic mean is not an important form of average, but it must be given some consideration, because it is appropriate in certain types of problems involving weighted averages. The nature of the harmonic mean and what is perhaps the simplest way in which to approach it may be illustrated by the following data, which may be assumed to represent essential facts regarding two purchases of a certain commodity, and in which the problem

³⁷John R. Stockton, *op. cit.*, p. 110.

³⁸*Ibid.*, pp. 118-119.

is the discovery of the average price in the two transactions:

<u>Date</u>	<u>Price per pound</u>	<u>Total Cost</u>
June 1, 1936	\$0.10	\$20.00
June 2, 1936	\$0.15	\$45.00

It might appear, at first glance, that prices featuring each purchase should be weighted by the total cost of each purchase. But price multiplied by total cost does not result in a reasonable or sensible product. Rather, the natural weight for the price per pound is the number of pounds, since the number of pounds represents the number of times the price is spent and is, therefore, the frequency. For this reason, in order to secure an appropriate weighted average, it is necessary to determine the number of pounds purchased on each of the dates. This result is achieved by dividing \$20.00 by \$0.10 and \$45.00 by \$0.15, thus discovering 200 and 300 pounds, respectively, as the appropriate weights. The problem may then be restated, with the purchases described as follows:

<u>Date</u>	<u>Price per pound</u>	<u>Pounds</u>	<u>Total Cost</u>
June 1, 1936	\$0.10	200	\$20.00
June 2, 1936	\$0.15	300	\$45.00
		500	\$65.00

Such a restatement makes clear the average price per pound as the total cost, \$65.00, divided by the total number of pounds, 500, or \$0.13 per pound.

The usual definition of the harmonic mean describes it as the reciprocal of the arithmetic mean of reciprocals of the measures, where frequencies are of the type illustrated by "total costs" in the illustration. The most commonly used procedure in calculating the harmonic mean differs somewhat from that utilized in illustrating the principle involved in the preceding paragraphs. Generally, reciprocals of the class measures are first discovered. The average is then taken in the usual manner, after which the reciprocal of that average is secured and described as the harmonic mean. This process may be illustrated,

utilizing the data described above, as follows⁽¹⁾,³⁹

<u>Purchase, or date</u>	<u>Price per pound</u>	<u>Reciprocal</u>	<u>Frequency</u>	<u>Product</u>
	\underline{m}	$1 \div \underline{m}$	\underline{f}	$(1 \div \underline{m})\underline{f}$
I. June 1, 1936	\$0.10	10	20	200
II. June 2, 1936	0.15	6.667	<u>45</u>	<u>300</u>
			65	500

$$M \text{ (of reciprocals)} = 500 \div 65 = 7.692$$

$$HM = 1 \div 7.692 = 0.13$$

$$\text{or } HM = 65 \div 500 = 0.13$$

Geometric Mean

The geometric mean is valuable in averaging percentages and ratios, and also in finding the average rates of growth, because it is not necessary to have intermediate values to determine the geometric mean when the total increase is known. The geometric mean is the n th root of the product of n number of values. When there are more than two items in the observation, it is usually necessary to use logarithms to compute the geometric mean.

Accounting Uses of Averages

An accountant employs some type of average almost every day.

Each of the major types of averages has the same purpose, one number

(1) It will be clear that calculations may be reduced by omitting the columns of reciprocals and obtaining the product $(1/\underline{m})\underline{f}$ directly as $\underline{f}/\underline{m}$, and similarly, by calculating HM directly as $\frac{\underline{f}}{(\underline{f}/\underline{m})}$ without reference to the M of reciprocals.

³⁹George R. Davies and Dale Yoder, Business Statistics, John Wiley & Sons, Inc., New York, 1937, pp. 80-82.

is typical of all others in the observation, but by using different types of averages different results are derived. If the observation is perfectly normal, then the mean, the median, and the mode are exactly the same. The geometric mean is always less than the arithmetic mean unless all of the variables are the same. The value of the harmonic mean is always lower than the value of the geometric mean and the arithmetic mean.⁴⁰ Each of the averages has a special purpose, but in most instances, the arithmetic mean has been used by the accountant because of its simplicity and its general understanding.

Some of the special accounting uses of averages are the following:

1. Averaging depreciation rates
2. Averaging inventory values
3. Averaging sales and products
 - a. by years
 - b. by seasons
4. Averaging earnings
5. Averaging wage rates
6. Averaging capital balances for distribution of partnership profits
7. Averaging accounts to determine a single date on which the account may be settled without loss to debtor or creditor
8. Averaging percentages

⁴⁰G. Udny Yule and M. G. Kendall, An Introduction to the Theory of Statistics, Charles Griffin & Company, Limited, London, 1940, p. 131.

Averaging depreciation rates. Averaging depreciation rates has two specific meanings:

(1) Averaging past depreciation rates which have applied to one particular asset and using this average rate in the future as a more nearly correct rate than were estimations. The Federal Bureau of Internal Revenue has attempted to do this in applying depreciation rates for income tax purposes. Many important trade associations also have committees on depreciation rates for particular industries.

(2) Averaging rates for different assets and using one composite rate for each different group of assets. For example, a "composite" or "blanket-rate" may be applied to all of the office machines which a company has, regardless of the length of life of each machine.

The following is an excellent description of the composite method:

The composite-life system contemplates depreciating, as a unit, a number of mixed assets assembled to perform a particular service but with each such unit having a different life expectancy. A simple illustration would be that of a filling station with buildings, structures, and runways taking one rate, tanks and pumps another, grease racks perhaps another, and office equipment still another. Instead of applying individual rates to each of these types of assets, however, the composite-life system calls for determining the mean life of the station; that is, getting a rate weighted by the component parts making up the whole and applying this rate to the total cost of the station and its appurtenances.⁴¹

⁴¹Gay Carroll, "The Group System of Depreciation," A.A.A. Bulletin, Vol. XXIII, No. 8, Dec. 15, 1941, p. 474.

Many oil companies have further elaborated on the composite rate system by segregating all assets of like characteristics and like expected lives. By grouping homogeneous units a better average rate is determined. This method has been called the "Group System of Depreciation."⁴²

Averaging Inventory Values. The methods of averaging inventory values will be discussed more thoroughly in the cost accounting section under inventories. The main purpose in averaging inventory values is to obtain one value which applies to all of the specific articles in the inventory, although purchases have been made at varying prices.

Averaging Sales and Production. For comparative purposes, the average of sales and production by years is important. When sales or production is averaged and then expressed as percentages of the average month, seasonal indexes are determined.

Averaging Earnings. To pay interest on bonded indebtedness and dividends to shareholders, the average earnings have to equal the total of the interest payments plus the amounts necessary for dividend payments. Average earnings is of prime importance to stockholders and bondholders.

Averaging Wage Rates. For use in computing payroll above the maximum work week, especially for salaried employees, the average

⁴²Ibid., p. 476.

rate of pay is helpful. The average wage rates may also be used for comparative purposes with other departments of the same company or with separate companies.

Averaging Capital Balances for Distribution of Partnership Profits.

One of the methods of distribution of partnership profits is the ratio of average capital invested by each partner. This is usually a weighted average with each different capital balance weighted either by the days, weeks, or months that the amount remains unchanged in the account.

Averaging Accounts. If numerous accounts, some due and some not yet due, are to be combined into a note, taking into consideration past due accounts, what would be the due date on a sixty day note? Obviously, each account would have to be weighted by the time which it was past due or not yet due to determine the focal date from which to date the note. Averaging dates of invoices and accounts is of importance also in bankruptcy settlements and overdue accounts.

Averaging Percentages. When percentages have the same base, the arithmetic mean may be used as the method of averaging the percentages. For example, if the sales of a company are \$100,000 and the expenses for each of the departments are:

	<u>Expenses</u>	<u>% to sales</u>
Department A	\$5,000	5%
Department B	4,000	4%
Department C	<u>3,000</u>	<u>3%</u>
	\$4,000 Avg. Exp.	4% Average per cent

The average per cent of expenses of each department to sales as a whole may be computed from the per cent of each department's expense to sales whenever the same base is used to derive the percentage figures. However, if the base from which the percentages are computed differs, then it is not possible to use the arithmetic mean. To illustrate, if the sales for each department and per cent of expenses to sales for that department are as follows, then the arithmetic mean is confusing.

	<u>Sales</u>	<u>Expenses</u>	<u>% Expenses to Dept. Sales</u>
Department A	\$5,000	\$5,000	100%
Department B	92,000	4,000	4.3%
Department C	3,000	3,000	100%

The arithmetic mean is 68.1% of the sales of the various departments. Any company which had expenses of 68.1% of sales would seem unduly hazardous, but the average expenses are not that high. The only method which will give a true average is to weight each percentage by the proper sales. By doing so, the average of 4% is derived.

Dispersion

In dealing with averages, other useful measures are those which show the difference between the average and the actual figures. For example, if each of two companies have average earnings for the past five years of \$10,000, when the arithmetic mean is used, the total earnings for both companies is \$50,000. However, one company may have made all of the \$50,000 in one year and no earnings in each of the other four years, while the other company may have made \$10,000

a year for the five years. In the first case there is a wide deviation between the actual figures which go to make up the average and the average itself, while in the second there is no deviation at all.

The Range. The simplest type of measure of dispersion is the range, which is the difference between the extremes of all the items in the array. In the illustration above, the range in the first case is from zero dollars to fifty thousand dollars, while the range in the second case is ten thousand to ten thousand, or no range.

Average Deviation. Another measure of dispersion which is easy to calculate and may be used with either the mean, the median, or the mode is the average deviation. The average deviation is the arithmetic mean of the difference of the actual figures from the mean of the data, disregarding the plus and minus signs of the deviation. The average deviation shows the average scatter of the items from the typical value, and is an absolute rather than a relative measure of the spread of the items from the average.

Standard Deviation. The standard deviation is probably more valuable than any of the other measures of dispersion. It takes into consideration all of the values of the entire distribution, and is derived by squaring the deviations from the arithmetic mean of the data, then finding the arithmetic mean of the squared deviations, and extracting the square root. The following simple illustrations show the computation of the average and standard deviations from the same series.

X Manufacturing Company

<u>Year</u>	<u>Sales in Thousands of Dollars</u>	<u>Deviations from Mean</u>	<u>Dev. Squared</u>
1939	3	-2	4
1940	5	0	0
1941	4	-1	1
1942	6	+1	1
1943	7	+2	4
	<u>25</u>	<u>6</u>	<u>10</u>

$$\begin{aligned} \text{Avg. } 25/5 &= 5 & \text{Avg. Dev. } 6/5 &= 1.2 \text{ Standard Dev.} \\ & & & \frac{10/5}{1.2} = 1.4142 \end{aligned}$$

The series with an average of five has an average deviation of one and a standard deviation of 1.4142. The standard deviation is often referred to as sigma (σ).⁴³

Quartile Deviation. Another measure of dispersion, the quartile deviation, measures the spread of the central items only. The extreme items do not have any effect on the quartile deviation. The first and third quartiles are obtained by a method somewhat similar to the method used to derive the median, that is, the values which are one-quarter and three-quarters of the number of items in the array are determined rather than the value of the mid item. One-half of the sum of the values of the first and third quartile give the value of the quartile deviation. This value may seem to be the same as the median at first glance, however, there is a difference. The median is the value which is in the middle of the array, while the quartile deviation is one-half of the sum of two values located one-fourth

⁴³For methods of computing the standard deviation when grouped data is employed see Stockton, op. cit., pp. 126-132.

and three fourths of the distance in the array. Sometimes the median will be the difference between the two quartile deviations, but in many other circumstances it will not.

Coefficients of Variation. The measures of dispersion already mentioned compare deviations in absolute amounts. That is, the standard deviation is in terms of sales dollars if the data are in sales dollars. The coefficient of variation is a relative measure of dispersion and as such may be used in comparing different types of values. The coefficients of variation measure dispersion in terms of degree of variation or percentage of variation. There are three different types of coefficients of variation: (1) relative dispersion obtained through the standard deviation as a percentage of the arithmetic mean; (2) relative dispersion obtained through the average deviation as a percentage of the median; (3) relative dispersion obtained through the values of the first and third quartiles as a percentage of the median.

Accounting Uses of Measures of Dispersion. The average and standard deviations are especially important to the accountant in the statistical analysis of time series. Two particular uses of measures of dispersion in the analysis of time series are summarized by Riggleman and Frisbee. They are: "(1) in comparing time series having widely different amplitudes of fluctuation; and (2) in combining several series of business data into one

composite series called a 'business index'.⁴⁴

In further analyzing time series of different amplitudes of fluctuation, Riggleman and Frisbee continue to say that:

These questions can be answered by reducing the variations to units of their respective standard deviations (or average deviations, if desired). If 77.20 pounds is the standard deviation for Smith, then a deviation of 115 pounds is $(115 \div 77.20)$ standard deviations, or 1.49 standard deviations. Similarly, 110 pounds is a variation of 1.42 standard deviations.

Units of average deviation are obtained in the same manner, namely by dividing the average deviation into the individual deviations, these individual deviations usually being from the median.

The reduction of series to terms of their respective standard (or average) deviations places data having widely different amplitudes of fluctuation on a comparable basis. One series, say bank clearings, may have deviations from the average amounting to millions of dollars, whereas another series, such as interest-rate percentages, may have deviations from the average that never exceed five or six. When the deviations of such series are reduced to units of their own respective standard deviations, the fluctuations in value become readily comparable, because they are stated in terms of a "normal" for each series. For example, a deviation of \$10,000,000 in bank clearings may be found to represent the same number of "normal" or standard deviations as a deviation of 1 per cent in interest rates.⁴⁵

⁴⁴John R. Riggleman and Ira N. Frisbee, Business Statistics, Second Edition, McGraw-Hill Book Company, Inc., New York, 1938, p.222.

⁴⁵Ibid., pp. 222-223.

CHAPTER VI

GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED

TIME-SERIES

Trends

Trends are a part of a statistical analysis called "Time Series." In time series, the results which come about in a business do so because of the passage of time. When changes which come about in businesses cumulate over a long period of time, and the changes are in one direction, there is a secular trend. Statisticians have not held strictly to the definitions of a trend that the line of growth has to be entirely in one direction, but limitations have only allowed the line to vary in one other direction. That is, a trend line may show growth and then a leveling off, but it cannot show continuing growth and leveling off.

To measure long-term movements of a business and to express them in some type of average relationship is the purpose of the trend analysis.

In the analysis of accounting data, there are four major methods of showing trend relationships:

1. Trend percentages.
2. Secular trends.
3. Profit trends.
4. Statement of application of funds.

Trend Percentage

The analysis of comparative statements produces far more important results than the analysis of single statements. A knowledge of how a company stands at one time or for one period is valuable; but a knowledge of the trend of sales, costs of sales, cash, inventories, and receivables is much more valuable than the mere financial condition at one time.

One method of analyzing comparative statements is through the trend percentage method. The principle of trend percentages consists in adopting one of the years, usually the first, of comparative statements as a base of 100% and then comparing the movements from the base period and expressing the movements as ratios or percentages of the base period. In the method of trend percentages, the trend is shown as a percentage of the first year. Gilman has the following to say about the trend percentage method:

It is, of course, obvious that the trend percentage method is based upon an assumption which renders it of little value for any other use than that of showing trends. It is a type of assumption somewhat resembling the one underlying ratios, although different in effect. In trend percentages it is assumed that the base year equals 100% or \$1 for each item in the analysis. Thus referring again to the Perfection Manufacturing Company, the method is based upon the assumption that the net sales in 1929

were equivalent to \$1 and the receivables at the end of 1929 were also equivalent to \$1, subsequent values of both these items being expressed in terms of these assumed 1929 values.

We have seen in a previous chapter that the basic assumption underlying the component percentage method and the ratio methods made them eminently practical for surveying relationships between items within a financial statement but at the same time made them inappropriate for the study of trends.

Similarly the assumption underlying the trend method is its most important feature as an aid to the survey of trends but makes the resulting figures of no value as an aid to surveying relationships between items of any one year. This point is of sufficient importance to justify further emphasis.⁴⁶

From the above it may be determined that the trend percentage method cannot be used under all circumstances. The method is not practicable if one tries to make a trend percentage of a combination of financial statement ratios. Trend percentages may be computed for two or a series of years, thus being useful as a measure of one year's operations as compared with that of the preceding year. This is not usually possible in the ordinary secular trend analysis.

The following simple illustration shows the method of computing the trend percentage. The illustration is from an actual company:

⁴⁶Stephen Gilman, Analyzing Financial Statements, Revised Edition, The Ronald Press Company, New York, 1934, pp. 116-117.

	<u>1940</u>	<u>Trend</u>	<u>1939</u>	<u>Trend</u>
Sales	\$704,301	114%	\$617,414	100%
Operating Expenses	643,587	113%	568,246	100%
Net Income before Income Tax	58,619	124%	47,287	100%
Income Tax	22,500	225%	10,000	100%
Net Income	36,119	97%	37,287	100%

By comparing changes from year to year in terms of percentages, it is easier to determine changes from time to time. Through the use of the trend percentage method, more than the two years above may be compared with any one of the years taken as the base, or 100%.

Secular Trend

Croxton and Cowden make the following statement regarding trends:

There are two important reasons for attempting to describe the trend of a series by some kind of curve. First, it may be desired to measure the deviations from trend. These deviations consist of cyclical, seasonal and accidental movements. Frequently the obtaining of these deviations is but one step in attempting to isolate cycles, in order to study them. Second, it may be desired to study the trend itself, in order to note the effect of factors bearing on the trend, to compare one trend with another, to discover what effect trend movements have on cyclical fluctuations, or to forecast future trend movements.⁴⁷

Trends may be determined for any type of data which continues over a period of time. The trends with which an accountant would

⁴⁷Frederick E. Croxton and Dudley J. Cowden, op. cit., p.385.

be likely to deal are trends of sales, production, inventories, expenses, assets, liabilities, and capital--the trends from financial and operating data of businesses derived from accounting statements and reports. Of all of the mathematical and graphical methods devised to measure trend lines, not one has been developed which automatically determines which is the best method to use on the data at hand. The one who does the measuring of a business trend also has to determine which of the various measuring devices is the important one to use under the circumstances. Because subjective methods are necessary to determine the type of trend line to use, it is usually necessary for the one who chooses the trend to understand the characteristics of the basic trend lines.

In determining the trend line which most closely follows the data which are being examined, it must be remembered that an average is being taken of the original data, but the average is not a constant figure. When the arithmetic mean is found for a group of numbers, the average remains the same. When the average is a trend line, the average is not the same for each year but increases or decreases depending upon whether the original data increases or decreases. Usually secular trend analysis is based upon long time trend. The number of years taken into consideration in determining the trend will, of course, cause variations in the trend line. In addition, it must be remembered that enough time must be considered in determining the trend line to counteract the effects of business cycles, unless the cycle is so severe as to affect the trend.

In considering trend lines only the simplest will be discussed

in this paper. Although the more advanced types of trend lines usually "fit" the data better than the simple straight line trends, the simplest types ordinarily are useful especially in analysis of individual businesses. The most common of the simple trends are:

1. Free hand trend.
2. Moving averages.
3. Method of semi-averages.
4. Method of least squares.

Free Hand Trend. Young in his textbook on business statistics makes the following statement regarding the free-hand trend:

The simplest method of indicating the secular trend is to plot the actual data as a straight-line curve and then throw a trend line across it free-hand without any computations. The position of such a trend line will not be so mathematically precise as that of others. It depends primarily on the judgment of the statistician and consequently will be constructed differently by different persons. However, in many cases in practical work this rough approximation is sufficiently accurate for the purpose at hand. It is particularly serviceable where the time available for constructing the line of trend is short.⁴⁸

The free-hand trend line has great possibilities for accountants. As the trend line can be drawn almost as quickly as the original data can be computed, charts which have the trends of the important items from the various accounting statements can be included along with the regular accounting statements. Although the information on the charts would not be as mathematically accurate

⁴⁸Benjamin Franklin Young, Statistics as Applied in Business, The Ronald Press Company, New York, 1925, p. 472.

as the trend lines computed from mathematical formulas, often the information presented would be just as valuable for management purposes, since the chart would show the general direction of the trend of various elements of a business.

Moving Averages. The method of computing a moving average has been discussed in the chapter on averages. A moving average may be employed for various purposes, however, and the computation of a trend line by using a moving average is one of the specialized uses.

When using the moving average method of computing a trend line, the time period chosen for the average is of utmost importance. The cyclical fluctuations represented in the actual data will throw the trend line off a great deal if the time period is not great enough to level off these cyclical fluctuations in computing the average. Theoretically, it is possible to choose a time period which takes into consideration the frequency of the cycle, but actually the cycle fluctuates irregularly and in importance so that sometimes the problem is difficult. The following outline from Young is helpful in considering the time period.

1. In general, the moving average should be based on a period equal to the period of the cycle to be removed or to some multiple of the period of the cycle.

2. If the cycle is irregular, the moving-average period should be equal to the average length of cycle or preferably to a higher multiple of this average. The same is true when the amplitudes vary, the cycles being uniform, or when both the cycles and amplitudes vary.

3. When the underlying trend of the series changes direction, the moving-average period should be reduced

to a minimum consistent with the length of the cycle.⁴⁹

The moving average method of computing a trend line is simple and easily computed; however, it cannot be brought up to date, as the average is always centered or placed midway in the time period. If the cycles are of even duration and amplitude, and the time period is accurately chosen, then the trend line is usually accurate enough for practical purposes, since the trend will follow the data but will not have all of the fluctuations of the original data.

Semi-averages. The method of semi-averages is one of the more easily computed of all mathematical trend line methods and can be used to advantage when the trend line is a straight-line. To determine the trend line by the method of semi-averages, divide the series into equal time groups and find the arithmetic average of the two groups. The mean of the first group becomes the trend value of the middle year of the group, and the mean of the second group becomes the trend value for the middle year of the second group. When the trend value for the two mean years is known, it is possible to determine the trend values for the intervening years by finding the difference between the two years and then dividing by the number of years between the two. By the addition or subtraction of the computed yearly trend increase or decrease from the mean of either of the groups, the yearly trend value may be secured. When only a graphic trend is desired, the two means may be plotted on a chart and a straight line drawn connecting the two points.

⁴⁹Ibid., p. 476.

If the number of years is odd, the central year is omitted to make the two groups even.

If the trend movement is very irregular, the original data may be broken into more than two groups and the mean of each of these groups taken to find the trend value for the middle item of each of the groups.

A variation of the semi-average method has been developed which uses the rise or fall in the trend as found in the above method, but the increase or decrease is added or subtracted from the mean of the original data rather than the means of the two groups. This method is a combination of the semi-averages and the least-squares, and while the result is usually not the same as that derived by either of the methods, there is little difference.

The Method of Least Squares. Mathematically, the simplest line which shows the relationship between two variables is a straight line. In averages, the arithmetic mean is the most easily computed of the mathematical averages. When dealing with two variables which have relationships, such as the sales of a company over a number of years, an average relationship may be computed which is quite similar mathematically to the arithmetic mean. However, instead of one value representing the entire series of values, a value is computed for each of the years making up the series. When the change between each of the years is exactly the same, the line is a straight line, when drawn on a chart.

The method of least squares is used to compute a line which is

straight and where the sum of the squares of the deviations of the original data from the line will be smaller than from any other line. The equation which is ordinarily used to represent a straight line is $Y = a + bX$. a is the Y value when X is zero, and the b value shows the amount of increase or decrease each year. In secular trend, X always represents the interval of time while Y shows the data which is dependent upon the passage of time, computed from the original data, Y .

Various formulae are available to be used to compute the a and b values. Simultaneous equations are considered the best mathematical method by some; others employ only a single equation. Either way produces the same result, so that the mathematical background of the accountant will probably be the determining element in the choice of a formula to compute the straight line by the method of least squares.⁵⁰

Monthly trend values. Business data are often considered on a monthly basis rather than on a yearly basis. The computation of a trend line to monthly data is no different from that for yearly data, only there are twelve times as many items, which means that usually more than twelve times as much labor is involved. Because of the labor involved in computing monthly trend values, it is usually better to determine the trend values from yearly data rather than monthly data, and then to convert the yearly trend into

⁵⁰For illustrations of the procedure of computing a trend line by the method of least squares see Oulton and Gordon, *op. cit.*, pp. 399-411 and John R. Stockton, *op. cit.*, pp. 219-226.

monthly items. It is important to know whether the original information is the total yearly data or the annual averages of monthly data, since the procedure is different in each case.

If the trend is fitted to monthly averages of yearly data, to find the monthly trend values, divide only the constant b by twelve. This is true when the equation $Y_x = a + bx$ is stated in terms of annual growth. When the trend is fitted to annual totals rather than monthly averages of yearly data, the a unit is divided by 12 and the b unit by 144 to reduce the annual data to monthly terms. Furthermore, the monthly data are usually shifted to the center of the month, since the midpoint of a month is usually considered representative of the month when the month is stated in terms of average data.

Profit Trends

The trend of earnings as computed by any of the above simple methods would show relationships which exist either in actual amounts of profit or in ratios of profit to net worth, sales, or other items. However, within the last generation, attempts have been made to relate the costs of production to sales in terms of quantitative analysis. Costs, of course, may be either fixed or variable. In accounting, the fixed costs are not always as fixed as they seem to be and, similarly, the variable costs are not always variable. There is, however, a relationship between the fixed and variable costs and this relationship may be computed mathematically to determine the average of the fixed and the variable

costs.⁵¹ Fixed and variable costs are considered in relation to the sales to determine to what extent the sales capacity has to do with profit. Likewise, relationships may be considered between the sales capacity and assets of the business to determine any possibilities of increases in the turnover of the various types of assets.⁵²

The Statement of Application of Funds

While one often thinks of the term "trend" as the analysis of relationships which exist within one or more items for a large number of years, the term is also used to express relationships which exist from one year to the next year. The Statement of Application of Funds is one method of summarizing the changes in purchasing power which have occurred in the business from one period to the next. The statement shows the increases and decreases in the funds which have resulted from the operation of the business. A detailed description of the meaning of "funds" as used in the heading of this statement is provided by Noble, Karrenbrock, and Simons:

The Statement of Application of Funds has been called: Statement of New Assets and their Application, Statement of Resources and Applications, Statement of Financial Benefits Earned and Employed,

⁵¹The method of computing relationships between fixed and variable costs is discussed in the chapter on cost accounting.

⁵²Full procedures for determining profit trends are considered by G. E. Knoeppel and Edgar G. Seybold, Managing for Profit, McGraw-Hill Book Company, Inc., New York, 1937, pp. 73-129. Similar types of analysis may also be found in the book by Walter Rautenstrauch, The Economics of Business Enterprise, John Wiley & Sons, Inc., New York, pp. 228-291.

Statement of Financial Changes, and the Where Got and Where Gone Statement.

Before discussing the construction of the statement, the meaning of the term 'funds' as here used should be explained. By 'funds' is meant the purchasing power, measured in dollars, both in various assets owned and credits incurred. The statement of application of funds is not an analysis of cash receipts and payments. The real purpose of the statement is to show what purchasing power was available during a period and how that purchasing power was used. The statement traces the flow of wealth into a business and its movements within the enterprise. Businessmen sometimes ask: "What has happened to the profits that we have constantly shown in our statements; why is our cash balance always so low?" "What happened to the proceeds of our bond issue; haven't we less cash now than we had at the beginning of the year?" The statement of application of funds answers either or both of these questions.⁵³

Gilman summarizes the description of the application of funds statement as follows:

One use of the increase and decrease method is found in the application of funds statement. This statement is based upon the double-entry feature of accounting and in its briefest (although least illuminating) form it might appear, for the Perfection Manufacturing Company, somewhat as follows:

**The Perfection Manufacturing Company
Summary Comparative Balance Sheet
(As of December 31)**

(Increase and Decrease Method of Analysis)

Assets:	<u>1929</u>	<u>1930</u>	<u>Increase</u>	<u>Decrease</u>
Cash	\$ 22,887.68	\$ 11,077.81	\$	\$11,809.87
Receivables	53,252.57	55,697.47	2,444.90	
Inventories	47,524.81	49,930.45	2,405.64	
Fixed Assets	101,484.78	100,579.21		905.57
Other Assets	<u>9,906.30</u>	<u>15,178.08</u>	<u>5,271.78</u>	
	<u>\$235,056.14</u>	<u>\$232,463.02</u>	<u>\$10,122.32</u>	<u>\$12,715.44</u>

⁵³Noble, Karrenbrock, and Simons, op. cit., p. 368.

Liabilities and Net Worth:

Current Liabilities	\$ 20,640.27	\$ 16,469.89	\$	\$ 4,170.38
Net Worth	<u>214,415.87</u>	<u>215,993.13</u>	<u>1,577.26</u>	
	<u>\$235,056.14</u>	<u>\$232,463.02</u>	<u>\$ 1,577.26</u>	<u>\$ 4,170.38</u>
Increase in Net Worth	\$ 1,577.26	Increase in Assets	\$10,122.32	
Decrease in Assets	<u>12,715.44</u>	Decrease in Liabilities	<u>4,170.38</u>	
Total	<u>\$14,292.70</u>			<u>\$14,292.70</u>

As would be expected the totals above are equal to one another. In a somewhat more explanatory form such a statement might appear thus:

Increase in Net Worth	\$1,577.26
Accounted for as follows:	
Increase in Assets	\$10,122.32
Decrease in Liabilities	<u>4,170.38</u>
	\$14,292.70
Less Decrease in Assets	<u>12,715.44</u>
	<u>\$1,577.26</u> 54

Funds may be provided or applied from various sources in the business. The following list describes the means of obtaining funds and the ways of applying those funds:

Sources from which a company may receive funds:

- (1) Increase in capital by investment.
- (2) Increase in capital by profit.
- (3) Increase in long term liabilities.
- (4) Sale of fixed assets and the sale of investments.
- (5) Decrease of net working capital.
- (6) Decrease of net deferred items.

Sources from which a company may apply funds:

- (1) Decrease in net worth by
 - a. Payment of cash dividend.
 - b. Buying outstanding capital stock or withdrawing of capital.
 - c. Loss.
- (2) Increase in investments and fixed assets.
- (3) Decrease in long term debts.
- (4) Increase of net working capital.
- (5) Increase of net deferred items.⁵⁵

Since some items which go to make up the profit of a business do not actually increase purchasing power, but are merely book entries, adjustments are necessary to show the net amounts which have been provided or applied. Such items as depreciation, bond discount amortized, organization expense written off, and others which affect the profit or surplus account but do not decrease the amount of available purchasing power, must be added to or subtracted from the profit so that the correct amount of purchasing power provided by profits will be shown.

The Statement of Application of Funds shows the increase or decrease in funds provided and how applied from various sources for the operations of the business. Usually only the net increases or decreases in assets, liabilities, and net worth are shown and the analysis of individual amounts is not always available. The trend percentage method is probably more valuable for measurements of specific item changes. The following application of funds state-

⁵⁵Noble, Karrenbrock, and Simons, *op. cit.*, pp. 369-371.

ment, Illustration V, shows in completed form the items which are important on the funds statement.⁵⁶

⁵⁶Ibid., p. 397.

Illustration V

STATEMENT OF APPLICATION OF FUNDS OF THE ROBERTS CO.

For The Year Ending Dec. 31, 19--

Funds Provided:

By Profits:

Net Profit as per Profit & Loss Statement		\$1,900	
Deduct--Profit on X Company Bonds	\$ 25		
Profit Taken Up on Acme Mfg. Co. Stk.	800	825	
		<u>\$1,075</u>	
Add--Loss on Sale of Delivery Equipment	\$ 100		
Depreciation and Loss of Tools	200		
Write-off of Organization Expense	500		
Amortized Discount on Bonds Payable	25		
Depreciation on Buildings	4,000		
Depreciation on Delivery Equipment	800	5,625	\$6,700
By Sale of X Company Bonds			1,025
By Issuance of Bonds Payable			49,000
By Sale of Common Stock			2,100
Total Funds Provided			<u>\$58,825</u>

Funds Applied:

To Increase in Sinking Fund	\$ 2,500
To Retirement of Preferred Stock	10,500
To Appropriation for Preferred Dividends	2,000
To Payment of Common Stock Dividends	3,000
To Purchase of Delivery Equipment	1,200
To Cost of Defending Patents	3,000
To Increase of Working Capital and Deferred Items (See Schedule)	36,625
Total Funds Applied	<u>\$58,825</u>

Schedule of Working Capital and Deferred Items

	19-- Jan.1	19-- Dec.31	Changes in Net Working Capital & Deferred Items	
			Increase	Decrease
CURRENT ASSETS:				
Cash	500	6,500	6,000	
Accounts Receivable	7,300	15,225	7,925	
Inventories	8,000	20,000	12,000	
DEFERRED CHARGES:				
Unexpired Insurance	600	500		100
Supplies	400	800	400	
Total Current Assets & Deferred Charges	<u>16,800</u>	<u>43,025</u>		

Illustration V, (Continued)

CURRENT LIABILITIES:

Accounts Payable	15,000	1,000	14,000	
Accrued Interest on Bonds Payable		2,000		2,000
Accrued Wages	800	300	500	
Accrued Taxes	500	600		100
Dividend Payable on Preferred Stock		2,000		2,000
	<u>16,300</u>	<u>5,900</u>		

**Increase in Working Capital &
Deferred Items**

	<u>36,625</u>
<u>40,825</u>	<u>40,825</u>

Seasonal Variations

The long time growth of a business is measured by trend lines. The regularly recurring fluctuations in time series are measured by seasonal indexes. The trend line is usually stated in terms of the actual data, but the seasonal factor is usually measured as an index number with the average month of the year being the base or one hundred per cent.

In the comparison of time series it is very often noted that there is a regular recurrence of busy and slack months of the year. For example, December is usually the month of the year which has the greatest amount of retail sales; however, August and September are usually very good months due to school children being prepared for return to their studies. The problem in retail selling is to prepare in advance for the high and low months and to be able to measure adequately the amount each month is above or below the average month. As has been stated above, it is usually more convenient to state the seasonal relationship in terms of index numbers than in terms of the actual data, as trend must always be considered in dealing with the actual data.

The accountant has unlimited possibilities in the determination of seasonal factors from the data with which he deals. Such items as sales, production, employees, inventories, cash, and in fact any item which has regular recurring fluctuations from year to year may be measured to determine the seasonal relationships which exist in each.

Measurement of Seasonal Variation

Numerous methods have been devised to measure the seasonal variation which exists in time series; however, there are five which are the most common. They are:

1. Ratios to moving averages
2. Ratios of the means of monthly items
3. Monthly percentages of yearly totals
4. Percentage of trend
5. The link relative

Since it is not the purpose of this study to examine thoroughly the methods of computing all types of statistical methods, and because of the space which would be necessary to illustrate thoroughly the methods of computing seasonal indexes, only a description will be attempted at this time. However, references are given to texts which adequately describe each of the various methods.

Ratios to moving averages. The most common method of computing seasonal indexes is by the method of moving averages. The method of computing a moving average was described in the chapter on averages. The computed average for each twelve month period is centered usually at the seventh month and then a percentage relationship is found between the twelve month moving average centered at the seventh month and the actual seventh month data. As has been shown in computing moving averages, twelve months are always covered by the average no matter whether the moving average runs from January to December or from February to January. When the seventh month is

the centering point for the average of the twelve months, July takes the average for the twelve-month period from January to December, August for the twelve-month period from February to January, September for the twelve-month period from March to February, and so on throughout the year.

The moving average centered at the seventh month is then divided into the actual data for that month and expressed as a percentage. That is, if the actual sales for a company are \$92,000 for July and the average sales for the twelve-month period from January to December are \$100,000, then the percentage relationship between the actual data and the moving average would be 92%. The per cent figures are called seasonal relatives, or specific seasonal relatives, and the seasonal relatives for like months are averaged to determine the seasonal index for that month. The average used is usually not the arithmetic mean of all of the relatives for a specific month, but is usually the median or the mean of two or three of the middle items. The reason for the median or a mean of two or three middle items is the elimination of any specific seasonal which may be distorted by being grossly different from the other seasonal relatives for that month. After determining a seasonal relative for each of the months, a correction usually has to be made so that the total of the year's seasonal relatives will equal 1,200 per cent, that is, to eliminate secular trend from the data. The "leveling factor" is determined by dividing the total of the seasonal relatives for each month of the year into 1,200, and then multiplying the result by each of the individual monthly

seasonal indexes. The result will give a total for all of the yearly indexes.⁵⁷

Ratios of the Means of Monthly Items.⁵⁸ One of the simplest of the methods of computing seasonal variation, while not the most suitable for all occasions, is the method of taking ratios of the means of monthly items. Data regarding sales, production, or any other seasonal information is arranged by months for a number of years. The number of years employed is determined by the business cycle for that type of business, as wide cyclical variation will tend to influence the seasonal relatives if the data do not include both the upswing and the downswing of the business cycle.

After arranging the data by months, the average for the data is obtained for each of the months; that is, if sales are being measured, sales for January for the number of years chosen would be averaged, usually through use of the arithmetic mean, then the average sales for all of the Februarys would be obtained. Likewise the average sales for each of the various months would be derived. When the average January sales, February sales, and so on for the year have been determined, the average total sales for the years would be found. By dividing the average total sales for the years by twelve, the average monthly sales would be determined. To find

⁵⁷For the complete procedure of computing seasonal indexes by the method of moving averages see John R. Stockton, *op. cit.*, pp. 174-185, or Davies and Yoder, *op. cit.*

⁵⁸For detailed examples of the above method see John R. Stockton, *op. cit.*, pp. 168-169.

the seasonal index for each of the months, each month is expressed as a percentage of the average monthly sales. For an illustration of the above information, assume that the average January sales are \$46,000 while the average monthly sales for the year are \$50,000--January would have a seasonal index of 92% of the average month.

Monthly Percentages of Yearly Totals.⁵⁹ By computing seasonal indexes through the method of monthly percentages of yearly totals, some of the error which may arise due to secular trend or cyclical variation may be eliminated. The first step necessary in the above method is to determine the percentage each month's data are of the total of the yearly data. For example, what percentage is January sales of 1942 to the total sales for 1942? Likewise, what percentage is the sales of each month in 1942 to the total sales of 1942? For each year under observation, the monthly sales are computed as a percentage of the yearly data.

After computing the individual monthly percentages, the average of all of the January percentages, the average of the February percentages, and the average for the percentages of each month is derived. If the average is the mean average, then the total of the monthly average for the year will equal one hundred per cent. Usually, however, instead of taking the arithmetic mean of the monthly percentages, the median or the mean of two or three middle items is taken to eliminate any of the items which may not be

⁵⁹For detailed examples of the above method see John R. Stockton, op. cit., pp. 174.

representative of the group as a whole.

The percentages of the yearly total are usually converted into percentages of the average month. When the total of the percentages for the year equals one hundred per cent, all that is necessary is to multiply by twelve. If the total for the year does not equal exactly one hundred per cent, then by dividing the total into 1200 the "leveling factor" may be derived. This is true because if the monthly percentages are expressed as percentages of the average month, the total percentages for the year would be twelve months times the average (100%) or 1200.

Percentages of Trend.⁶⁰ If the secular trend has already been computed, one of the most satisfactory methods of computing seasonal indexes is by computing the percentages of the individual data to the monthly trend. That is, divide the original data by the monthly trend and multiply by 100. When each month of the series has been computed as a percentage of the trend for that month, then an average is taken of all of the years for that month. That is, the average of January for the years included in the study is taken; similarly for February and all of the other months. The arithmetic mean or the median may be used in averaging the percentages for each month, depending upon the fluctuations of the data; but the total of the percentages for the year will have to be adjusted to equal 1,200 per cent for the entire year. This will usually be accomplished

⁶⁰For detailed examples of the above methods see Higginson and Frisbee, *op. cit.*, pp. 318-320 or Croxton and Cowden, *op. cit.*, pp. 460-471.

by dividing the derived total into 1,200 and multiplying each index by the quotient.

The Method of Link-Relatives. The following description of the method of Link Relatives is taken from Higgleman and Friesbees: while the method is not the easiest to understand, it has many advantages over other methods at times. Especially is this true when dealing with data which are not on exactly comparable bases.

One of the best known methods of computing seasonal indexes is the link-relative method. The process, however, is somewhat more complex than those just described. The computation (assuming monthly data) is as follows:

1. Divide each January figure (actual data) by that for the preceding December. Divide each February figure by that for the preceding January. Divide each March figure by that for the preceding February, and so on throughout the entire series. These ratios or percentages are called "link relatives." Place the link relatives in 12 columns, one containing all the ratios of January to December, another containing all those of February to January, and so on.

2. The next step is to select a typical link-relative item which will represent each monthly group. The item selected is usually the median, although an arithmetic average is ordinarily more appropriate when the number of observations is small.

3. Each median link relative shows the typical relation of each month to the preceding month. The next step is to relate the median link relatives to a common base, for which the month of January may be chosen; this month then becomes the starting point or 100 per cent. The resulting percentages, obtained by relating each median link relative to the common basis of reference, are known as "chain relatives." The January chain relative will, of course, be 100 per cent, since this is assumed as the starting point or basis of reference. The February chain relative will be the same as the February median link relative (being the February median link relative multiplied by the January chain relative, or 100 per cent). The March chain relative is the March median link

relative multiplied by the February chain relative. The April chain relative is the April median link relative multiplied by the March chain relative. Continue this process of multiplying the median link relative for each month by the chain relative for the preceding month.

4. The new January chain relative, obtained by multiplying the old January median link relative by the December chain relative usually does not equal the original January chain relative of 100 per cent; this is due to long-time trend and other influences. If the trend is in arithmetic progression, the discrepancy may be corrected as follows: Divide the discrepancy by 12. If the trend is upward, subtract $1/12$ from February, $2/12$ from March, $3/12$ from April, etc., until finally $11/12$ of the increment is subtracted from December. The adjustment is made by addition if the trend is downward. If the adjustment must be made in geometric progression, or some other curve form, an accurate adjustment is more difficult, but the process just described may be used as an approximation which is satisfactory for most practical business purposes.

5. The series of adjusted chain relatives gives each month as a percentage of January. The next step is to reduce these values to percentages of the average monthly figure in a normal year. To do this, merely average arithmetically the figures for the 12 months and divide each monthly figure by this average. The final result will be the index of seasonal variation for the month.⁶¹

Accounting Uses of Seasonal Indexes

In any business concern, a knowledge of the seasonal pattern of that business is helpful in determining production and sales policies. Some of the most important of the accounting uses are:

1. Estimating monthly inventories
2. Estimating monthly and quarterly sales

⁶¹Kiggleman and Frisbee, *op. cit.*, pp. 322-323.

3. Estimating monthly production
4. Estimating desired number of employees
5. Estimating seasonal advertising

In either a production or a distribution industry it is important to know approximate requirements for inventories. While the inventories for a selling establishment follow a somewhat similar seasonal pattern to the sales, in a production industry the inventories and the sales seasonal requirements may be exactly opposite, depending upon the time necessary to convert the raw materials into finished goods. Likewise, the seasonal pattern for the raw materials and the production requirement may not be in exact agreement. The only way to determine the seasonal requirements for all of the above desired series is to compute the seasonal index from the data which the company has at its disposal. While it is also possible to obtain seasonal indexes from most of the trade associations, the indexes are better used for comparative purposes with the company's own computed indexes rather than for estimating the individual company's requirements, as it is possible that the trade association's seasonal indexes and the company's seasonal indexes may not be in exact agreement.

In addition to using the seasonal indexes for planning, they are also employed in the determination of cyclical indexes. Through the elimination of trend and seasonal of any series, the cyclical conditions will appear. A further discussion of the elimination of seasonal from time series to determine cyclical conditions is found in the discussion of "Cyclical Variation."

Cyclical Variation and Forecasting

In the analysis of time series data, the accountant considers four basic types of movements:

1. Secular trend
2. Seasonal variation
3. Cyclical variation
4. Erratic movements

The secular trend, as already described, is the long-term growth or decline of a business. During the time which is considered by the trend period, variations may also occur from month to month and from year to year. Even though these fluctuations do occur in the data, the basic movement is either up, down, or constant. The average growth or decline may be measured and is considered the trend line.

The regular variations in the data which recur each year, or each season, are called seasonal variations and are usually stated as index numbers--the ratio of each month's average data to the average month for a series of years. When the activity of a business is such that the actual conditions are equal to what the estimated trend and the seasonal are for that time, the business is said to be normal. If there is no seasonal variation, then conditions are normal when the actual conditions equal the trend.

When the normal conditions have been determined, any variations above or below normal are due to either a cyclical cause or to some erratic cause, or to a combination of both causes. The

business cycle, while recurring periodically, does not have any exact time schedule to follow, as does the seasonal index. However, the business cycle does follow somewhat of a set pattern in its course. Usually there is a period of prosperity followed by a decline until a low period is reached. From the low depression period there is an improvement until the peak of prosperity is reached again. While the period between peaks of prosperity and depths of depression is of different time lengths and the heights of prosperity and depths of depression vary in intensity, time series data for business have continued to show the recurring prosperity and depression cycles.

Normal in Business Statistics

As has been mentioned above, the business cycle is often measured from normal, the normal being the trend after the elimination of seasonal influences. The basic formula to determine normal would then be $T \times S$, T being trend and S being the seasonal. The actual sales or production figure would include, besides trend and seasonal, such items as cyclical (C) and any erratic fluctuations (I). The formula for the actual sales or production data would then be $T \times S \times C \times I$ or trend times seasonal times cyclical times erratic. The cyclical and the erratic are almost impossible to separate, so usually the cyclical and the erratic are considered together, as the cyclical factor and the formula would then be $T \times S \times C = \text{Basic data}$. $T \times S$ is normal, so to obtain the residual information on the cyclical, all that is necessary is to divide the basic data by the normal $\frac{T \times S \times C}{T \times S} = \text{Cyclical}$. The seasonal and cyclical variation will, of

course, be indexes.

Thus what is left from the sales figure after the elimination of seasonal and trend gives the cyclical fluctuation of the business. This figure, stated as a percentage, shows whether the business is above or below the normal (100%) for the business.

Base of Cyclical Indexes

Sometimes, when an index of cyclical variation of an individual business is compared with a cyclical index of either a trade association or a government publication, the indexes seem related but do not fluctuate in the same proportion. For example, the cyclical index for a trade association of a wholesale manufacturer of hardware may be 80% while the index of an individual hardware company doing business in a mining town where the fluctuations show extreme deviations between good and bad times may be 70%. That of another hardware company in an area where the deviations vary only slightly as the result of diversified industries might be 90%.

At first, it seems that there is no relationship between these three figures. Yet, if they are reduced to a common denominator, or if their fluctuations are reduced so that their average amplitude will be on the same basis, they might appear to run in a similar curve. To reduce an individual company's business index and a trade association index to comparable terms, the deviations from the normal of each are expressed in terms of their average or standard deviation.⁶²

⁶²Riggelman and Frisbee, *op. cit.*, p. 339.

The series with extreme deviations from normal will have a much larger standard or average deviation than the series whose deviations from normal are much less. When the large standard deviation is divided into the large deviations from normal, the amount of the deviation will be comparable with the series which has the smaller standard deviation, provided the series with the small deviations is reduced through its standard deviation.

TABLE II

Comparing two series in terms of
their Standard Deviations

Year and Quarter	% dev. from Normal X Co.	% dev. $\frac{\%}{\sigma}$ $\sigma = 8.7$ X Co.	% dev. from Normal Y Co.	% dev. $\frac{\%}{\sigma}$ $\sigma = 10.3$ Y Co.
1937				
First	+ 8	+ .92	+ 9	+ .87
Second	+12	+1.38	+14	+1.36
Third	+10	+1.15	+12	+1.17
Fourth	+ 5	+ .57	+ 6	+ .58
1938				
First	- 5	- .57	- 6	- .58
Second	- 7	- .80	- 8	- .77
Third	-10	-1.15	-12	-1.17
Fourth	-10	-1.15	-12	-1.17

Source: adapted from Riggleman and Frisbee, *op. cit.*, p. 340.

Table II shows comparative data adjusted in terms of standard deviations from normal. Note that the data are fairly consistent when compared in terms of standard deviations, yet they seem further apart when compared in terms of actual deviations.

By finding the correlation between the two cyclical series in terms of its standard deviation, it is possible to forecast the business conditions of one series from the other. If, in comparing a department store's cyclical condition with the estimated future condition of the department stores of the country at large, the standard deviation from normal is obtained for both series, one standard deviation from normal may mean a 5% change in the condition of the department stores of the United States at large, while one standard deviation may mean a 10% change in the local department store's condition.

It is possible to receive forecasting information on almost any type of business from professional sources, and when compared with the company's own business condition through such devices as correlating the standard deviations from normal of each series to find the relationship one has to another, it may be used in forecasting for an individual business.

The following example of the procedure for forecasting sales is taken from a classroom test devised by Professor W. D. Rich:⁶³

Determine sales forecast of X business for the first two quarters of 1941 by comparison with forecast of general business from data below:

Year and Quarter	Actual Sales in Thous.	Trend ordinates	Seasonal Index	Normal	Percentage of actual to normal
1940					
1st Quarter	86	89	98	87.2	98.6
2nd Quarter	88	90	99	89.1	98.7
3rd Quarter	93	91	101	91.0	101.1
4th Quarter	95	92	102	93.8	101.2

⁶³Visiting Professor of Accounting at Louisiana State University in summer of 1941.

The standard deviation of X Business is 10%
The standard deviation of general business is 12%
Forecast of general business for 1941 is:

First quarter 103% of normal; Second quarter 106% of normal

If summation products of standard deviations of general business and X Business is 19.2, and there were 20 quarters included in the study up through 1940, what is the coefficient of correlation?

If the standard deviation of general business is 12%, and the forecast for general business is 3% above normal or $3/12$ of a standard deviation, the forecast for X Business would be $3/12$ of its standard deviation above normal, or $3/12$ of 10%, which is 2.5%. The cyclical index of X business would be 102.5%.

By multiplying 102.5 % by 91.2 thousand dollars, (the normal obtained by multiplying the seasonal, 98%, by the trend which would be 93 thousand dollars), the derived figure of 93.5 thousand dollars would be the sales forecast for the first quarter of 1941.

The procedure for the second quarter is similar. The cyclical index would be 105%, the trend would be 94, the seasonal, 99, giving a normal of 93.1 with a resulting sales forecast of 97.8 thousand dollars.

If the summation products of the standard deviations of general business and X business is 19.2 with 20 quarters used, the coefficient of correlation would be found from the formula:⁶⁴

⁶⁴Kidggleman and Frisbee, op. cit., footnote p. 262. y' is the deviation from the mean of the Y values, (X Business); x' is the deviation from the mean of X (General Business). The mean in both instances is the normal of 100%. See Chapter VII for meaning and use of coefficient of correlation.

$$r = \frac{\sum x'y'}{n}$$

$$r = \frac{19.2}{20}$$

$$r = .96$$

If a company's sales or cost indexes are comparable to one or more different indexes published by any of the various agencies, it is possible to take the cyclical index from this agency and multiply it by the company's trend line figures so as to give a resulting amount in dollars which would be comparable to the sales figure. If the derived amount is above the sales, it shows that the sales are below the normal condition under the cyclical conditions which were taken.

Any advantages in such manipulation would be the saving in time necessary for getting the cyclical figure, and the figure would be in dollars and cents which could be compared directly with the sales figure.

To illustrate this, suppose the company's sales for a given month is \$7,200.00, the trend of the sales of the business is \$10,000.00, and the seasonal index has been computed to be 90% of the average month's sales. To obtain the cyclical index of the company, it is necessary to multiply: 90% x \$10,000 = \$9,000, which is a reasonable figure in view of the company's trend and the seasonal factor.

Next, the month's sales are divided by \$9,000, the normal figure, which gives: \$7,200 ÷ \$9,000 = 80%

The cyclical index is 80%. If the general business condition index is 81%, the two are comparable as percentages. Many executives demand figures in dollars and cents when comparisons are made, so if the 81% is multiplied by the \$9,000, the resulting figure is \$7,290, which indicates the company is \$90 or 1% below normal business conditions of the entire general activities. The same results come about if 1% of \$9,000, the normal, is taken. By adding this \$90 to the sales figure, a normal sales under general business conditions is derived, which is \$7,290. Either method produces the same results and shows the sales figures to the executives in dollars and cents under normal conditions of the business and under normal conditions of general business.

CHAPTER VII

GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED

INDEX NUMBERS -- CORRELATION

Index Number

The accountant seldom needs to compute business indexes, but the use of published index numbers enables him to be enlightened about matters of importance to him and to his concern, such as relative prices of retail goods, wholesale goods, or stocks and bonds. The purpose of the following discussion is to enable the accountant to understand the computation of index numbers, rather than to show him how to compute business indexes for his own use. Nevertheless, in some instances it may happen that the accountant will have an opportunity to compute index numbers for his own firm.

While simple relatives are not usually placed in the category of index numbers, they are the foundation for any type of index. Simple relatives are the percentage relations between two items. For example, if the output of a manufacturing firm was 100,000 units in 1941 and 120,000 units in 1942, the percentage relation between 1942 over 1941 is 120% ($120,000 \div 100,000$). If the firm produced 130,000 units in 1943, the relative would be 130%

(130,000 \pm 100,000) over 1941 or 108% (130,000 \div 120,000) over 1942. Thus, one can see that seasonal indexes and cyclical indexes are types of index numbers, the seasonal index being a simple relative with the average month of the year as the base, and the cyclical index using "normal" as the base.

Business index numbers are devised for the purpose of measuring relations between groups of related business data, in terms of time periods, places, or categories. Most index numbers at the present time are price indexes, but quantity or quality indexes may be computed. For the accountant, index numbers computed outside the company may serve the following purposes:

1. Price index for deflation of a value series.
2. Cost of living index for wage stabilization.
3. Volume index for comparative purposes.
4. Forecasting indexes for correlation with company's index for forecasting company's business.
5. Price indexes for estimating reproduction costs.

Index Number Construction

Averages of simple relatives. The Louisiana State University Bureau of Business Research publishes an "Index of Louisiana Business Activity" computed by averaging the simple relatives obtained by using the average month of 1937-39 as the base for the following series: Department Store Sales, Freight Carloadings, Bank Debits, and Payrolls. They are given the following weights in order of their importance in the index: department store sales, 1/6,

freight carloadings, $1/6$, bank debits, $1/3$, and payrolls, $1/3$. The simple relatives are computed by link relatives, with the average month of 1937-39 equaling 100%. All series except the payrolls are adjusted for seasonal variation.

Since the information is received from different firms each month, it is impossible to compute a simple relative of total department store sales, freight carloadings, or the other items. The information from the total available firms is compared each month with the same firms for the preceding month. That is, the total department store sales for all of the available firms for December is divided by the total sales of the same firms for November. The result of this computation is called a link relative.

If all of the firms have reported for the base period, 1937-1939, a monthly average may be obtained for the department store sales for the period. Any one month's sales of the three years may be divided by the average month's sales to determine the index of department store sales for that month. When the index computed from the average month's sales is multiplied by the link relative of the next month, the same index is derived as when the average month's sale is divided into the actual monthly sales. The following example, using quarters instead of months and one year instead of three, illustrates the principle.

	Sales (000 omitted)	% of Actual to Average	Link Relative (Sales divided by preceding month) %	Chain Relative (Chain to Link of next month) %
1st Quarter	8	55		55
2nd Quarter	10	69	125	69
3rd Quarter	15	103	150	103
4th Quarter	25	173	167	173
Total	58			
Average	14.5			

The same percentage is derived for each quarter when the link and chain method is used as when the percentage of each quarter's sales is divided by the average quarter's sales. That is, $8/14.5 = 55\%$; $10/14.5 = 69\%$; $15/14.5 = 103\%$; and $25/14.5 = 173\%$. When 55% is employed as the starting chain, then $55\% \times 125\% = 69\%$; $69\% \times 150\% = 103\%$; $103\% \times 167\% = 173\%$.

Sometimes it is not possible to have all of the same firms represented in the base period. When data for all of the firms are not available for the base period, link relatives are computed for the available firms for each of the months or quarters. These are then chained, the first period being the base, or 100%. Next an average of the chain relatives for the base period desired is obtained, and the average is then divided into the chain percentage to obtain the desired index. This is illustrated in the following example:

	Sales (000 omitted)	Link Relative	Chain Relative	Index
First Quarter	8		100.00	55
Second Quarter	10	125	125.00	69
Third Quarter	15	150	187.5	103
Fourth Quarter	25	167	<u>312.5</u>	
Average			181.25	

The link relative is computed by dividing the monthly sales by the preceding month's sales. The chain relative is computed by having the first period equal 100%, then by multiplying the chain relative for that period by the link relative for the next period. ($100\% \times 125\% = 125\%$), ($125\% \times 150\% = 187.5\%$), ($187.5\% \times 167\% = 312.4\%$). By averaging the chain relative for the period desired as a base—in the example the total year's sales is the base—the average period's index (181.25) is determined on the basis of the chain relative. By dividing each chain relative by the index for the average period, the index for each period is derived. When the sales are for a known number of firms, the simple relative computed by any of the above three methods is the same. Obviously, it is much wiser, when possible, to compute a simple relative by dividing the month's data by the data for the average month or period than it is to compute link relatives and then chain the link relatives by either of the above methods.

To adjust the data for seasonal variation, divide the computed simple relative by a previously computed seasonal index. The method of computing seasonal indexes is explained in Chapter VI.

After the simple relatives are computed, weights may be assigned by any arbitrary method. To obtain an index which has significance, such necessary essentials as accuracy in computation and gathering of original information, comparability of the various series which go to make up a composite index, and representativeness of the firms which go to make up the sample from which the original relatives are made, need to be considered. It usually happens that any written or printed number is accepted as being accurate without further information. The figure is not always accurate and its correctness should be determined if the index number is to be employed in further analysis. It is also usually best to choose as the base years time periods about which the person who avails himself of the information has some knowledge. When a place is used as a base, then actual happenings at the place should be known to the user of the index or the index may not be as useful as if true conditions are known.

Aggregate Indexes. Instead of computing the relative first, and then averaging relatives, it is possible to obtain averages of the prices or units first and then compute index numbers from the averages of the prices or units. In a price index, the usual method is to weight the price by the quantity of each article, while in a quantity index, price weights the quantity. To illustrate the com-

putation of an aggregative index, the following are the sales prices for various materials of an assumed company for July and August, 1943.

July, 1943			
Material X	P_0 Average Sales Price per unit	Q_0 Units Sold	P_0Q_0 Sales Value
X	\$1.00 per gallon	10,000 gallons	\$10,000
Y	25.00 per ton	1,000 tons	25,000
Z	.25 per foot	50,000 feet	<u>12,500</u>
Total sales value (P_0Q_0)			\$47,500

August, 1943			
Material	P_1 Average Sales Price	Q_1 Units Sold	P_1Q_1 Sales Value
X	\$1.25 per gallon	9,000 gallons	\$11,250
Y	30.00 per ton	1,000 tons	30,000
Z	.30 per foot	60,000 feet	<u>18,000</u>
Total sales value (P_1Q_1)			\$59,250

P_0 = Price in base period.

Q_0 = Quantity sold in base period.

P_1 = Price in first period after base period.

Q_1 = Quantity sold in first period after base period.

P_0Q_0 = Value in base period.

P_1Q_1 = Value in first period after base period.

By holding the quantity sold in the base period constant, another group of figures may be determined, as follows:

August, 1943			
Material	P ₁ Average Sales Price in Aug.	Q ₀ Units Sold in Base Period	P ₁ Q ₀ Value
X	\$1.25 per gallon	10,000 gallons	\$12,500
Y	30.00 per ton	1,000 tons	30,000
Z	.30 per foot	50,000 feet	<u>15,000</u>
Sales Value August prices, July quantities (P ₁ Q ₀).			\$57,500

A relative percentage may be obtained by comparing any two of these three total sales value figures; however, if a price index is needed, it is better to use the same quantity weights with prices varying. So, to determine an index of prices of January and February, January, the base period, would be 100% $\frac{P_0 Q_0}{P_0 Q_0}$ or $\frac{47,500}{47,500} \times 100 = 100\%$. The August index would be $\frac{P_1 Q_0}{P_0 Q_0}$ or $\frac{57,500}{47,500}$ or 121%.

Various methods have been devised for weighting the different prices to obtain a satisfactory index. The following are the most common:⁶⁵

1. Use base period quantities as weights.
2. Use given period quantities as weights.

⁶⁵Frederick E. Croxton and Dudley J. Cowden, op. cit., pp. 592-597.

3. Use the average (or total) quantities of base and given years.
4. Average together the quantities for all the years which the index numbers include.
5. Average together the quantities of several years which are thought to be typical.
6. Determine the highest common factor.
7. Make two index numbers, each with a different set of weights, and average the two together, usually geometrically. (Fisher's Ideal Index Number).

Table of Most Common Business Indexes

While a list of all of the business indexes which are made in the United States and foreign countries is not available, some of the better known of the indexes with references as to where they can be located is given below.⁶⁶

Most Common Business Indexes (publishers shown by reference letters)

I. Commodity Prices

1. Index of Wholesale Commodity Prices (U. S. Bureau of Labor Statistics) (a, b, c, d, e, f) (published weekly).
2. Dun and Bradstreet Wholesale Commodity Price Index. (a, g, h) (monthly).
3. Daily Weighted Index of Thirty Basic Commodities. (g and newspapers).

⁶⁶For lists similar to the one given above with methods of computation see John R. Stockton, *op. cit.*, pp. 250-273, and Frederick E. Croxton and Dudley J. Cowden, *op. cit.*, pp. 612-650. The most complete list of business indexes with publication information is found in Donald H. Davenport and Frances V. Scott, An Index to Business Indexes, Business Publications, Inc., Chicago, 1937, 187 pp.

4. Prices Received by Farmers. (a, h, i) (monthly).
5. Fairchild Publications Retail Price Index. (a, d) (monthly).
6. U. S. Department of Labor, Bureau of Labor Statistics
Retail Food Price Index. (a, b, h, d) (monthly).

II. Cost of Living and Purchasing Power of the Dollar

1. Bureau of Labor Statistics Cost of Living Index. (a, b, h, f) (monthly).
2. National Industrial Conference Board Cost of Living Index. (a, h) (monthly).

III. Production

1. Index of Industrial Production of the Board of Governors of the Federal Reserve System. (a, b, d, e, c) (monthly).
2. Crude Petroleum Production. (U.S. Dept. of the Interior) (a, d, g) (weekly).
3. Electric Power Production. (Edison Electric Institute) (a, g) (weekly).

IV. General Business Activity

1. Business Activity. Business Week. (a, j) (monthly).
2. New York Times Business Activity. (k, a) (monthly).
3. Cash Income from the Sales of Farm Products. (a) (monthly).
4. Freight Car Loadings. (a) (monthly).
5. Corporation Profits. Standard Statistics Company, Inc. (a, h) (quarterly).
 - a. Survey of Current Business.
 - b. The Federal Reserve Bulletin.
 - c. Monthly Review of the Twelve Federal Reserve Banks.
 - d. The Commercial and Financial Chronicle.
 - e. The Wall Street Journal.
 - f. Monthly Labor Review.
 - g. Dun's Review, Statistical Supplement.
 - h. Bulletin of Standard Statistics.
 - i. Crops and Markets.
 - j. Business Week.
 - k. New York Times.

Correlation Analysis

In the analysis of any two items which seem to be associated, methods of correlation tend to disclose the relationships. Ordinarily, a business man simply observes correlation between two items. He says, "I have noticed that every time the current ratio of my business goes up, the current ratio of my trade association also rises, and when the trade association's ratio drops, mine is down also."

This type of reasoning in analyzing statements is used to a great extent, but if a business man mathematically correlates the items, he secures a more reliable basis for his estimates. However, mathematical analysis by itself is sometimes misleading. Riggleman and Frisbee quote the statement made by M. C. Kerty, past president of the American Statistical Association:

The dangers that lie in undue reliance upon coefficients or correlation, the harmonic analysis, and other forms of rigid mathematical treatment of complex statistical data can hardly be overestimated. I am inclined, in fact, to believe it would be a matter of fundamental principle for all statistical conclusions to be reached primarily through logical and experimental processes, supplemented by a very simple numerical and graphical analysis. The more elaborate mathematical treatment would then be applied, if necessary, as a check and verification of the results that have been arrived at by these other means.⁶⁷

An illustration to clarify the use of simple correlation is given below. In this illustration, which is hypothetical, the corre-

⁶⁷Riggleman and Frisbee, op. cit., p. 266.

lation is between the current ratios of a single company and the trade association of which it is a member. The current ratios are the ratios between current assets and current liabilities, and in this illustration are expressed as decimal figures. The illustration below shows the assumed ratios for a five-year period:

Current Ratios for Company Y and the Trade Association of Which It Is a Member

Year	Trade Association (X)	Company Y (Y)
1936	2.5	2.0
1937	2.7	2.5
1938	3.0	3.0
1939	3.0	2.9
1940	2.9	2.7

A line somewhat similar to that computed for trend analysis is computed to show the estimated amount of the company's ratio when the trade association ratio is known. Various formulas may be used, the one below being used by Stockton.⁶⁸ It is derived from the normal equation $Y_0 = a + bX$.

$$a = \frac{\sum X^2 Y - \sum X Y \cdot \sum X}{N \cdot \sum X^2 - (\sum X)^2}$$

$$b = \frac{N \cdot \sum XY - \sum X \cdot \sum Y}{N \cdot \sum X^2 - (\sum X)^2}$$

X is the independent variable or the trade association ratio

Y is the dependent variable or the company's ratio

N is the number of years, in this instance, five

⁶⁸John R. Stockton, op. cit., p. 306.

In working out the equations it is found that $a = -2.45$, $b = 1.8$; when placed in the normal equation $Y_0 = -2.45 + 1.8X$. When X is known, it is possible to estimate Y . If the current ratio for the trade association for 1941 were 3.0, then, substituting 3.0 for X in the equation, it is found that the estimate for the period is 2.95 for Company X. In analyzing further this situation, it is possible to find the standard error of estimate of this problem and thus to see the probable variation from the estimate.

The standard error of estimate measures the average amount the computed values deviate from the actual amounts. This measure of reliability of the estimated values, which is the square root of the sum actual values less the computed values divided by the number of cases, is computed somewhat in a similar manner as the standard deviation. The formula for the standard error of estimate is:

$$S_y = \sqrt{\frac{\sum (Y - Y_0)^2}{N}}$$

When the standard error of estimate is taken in conjunction with the regression equation, the chance of the estimate falling within plus or minus one standard error of estimate value from the regression equation value is 68 out of 100.

The coefficient of correlation is often used to see how closely related any two items are.

The formula for the coefficient of correlation is:⁶⁹

⁶⁹John R. Stockton, *Ibid.*, p. 318.

$$r = \frac{\frac{\sum XY}{N} - \left(\frac{\sum X}{N} \cdot \frac{\sum Y}{N} \right)}{\sqrt{\frac{\sum X^2}{N} - \left(\frac{\sum X}{N} \right)^2} \sqrt{\frac{\sum Y^2}{N} - \left(\frac{\sum Y}{N} \right)^2}}$$

The coefficient of correlation of the above illustration is .97, indicating a high degree of correlation.

The illustration above relates to balance sheet ratios. It is possible to correlate not only balance sheet items, but also the profit and loss statement items, as well as ratios which result from a comparison of balance sheet and profit and loss items. Investigation of sales trends, expense ratios, inventory turnovers, production, and other operating data may be done by correlating data derived from an individual business with those derived from one or more similar businesses.

CHAPTER VIII

GENERAL ACCOUNTING STATISTICAL METHODS, CONTINUED

STATISTICAL PRESENTATION OF ACCOUNTING DATA

Tables

The accountant is trained in the presentation of statistical data through the various accounting statements which he constructs. The Balance Sheet, the Statement of Profit and Loss, the Statement of the Cost of Goods Manufactured—are all statistical tables which accountants have developed to present their work in the most acceptable manner. Any accountant is familiar with the style, the order of presentation, and the accepted methods of construction of each of the various statements because they are standardized as much as possible.⁷⁰ However, other numerical data with which the accountant works can be presented to management in tabular form, and they should be properly presented.

The accountant must remember that in the presentation of his statistical data he is not working with professional statisticians. Many of the executives with whom he deals are unable to understand

⁷⁰Any good textbook on accounting has illustrations of proper arrangement and form of the major statements.

thoroughly even the standardized accounting statements. The entire problem of tabular construction is in the method of presenting the information. The data are already classified into separate categories whenever they are collected. To put the data into properly presented form so that a person with an elementary knowledge of statistical methods or a non-technical person can understand what is being presented, is the purpose of tables and charts.

Practically all of the tables which an accountant is called on to construct are of the "special-purpose" type, rather than the "general-purpose" tables. "General-purpose" tables are constructed to show all of the information in detail, such as the tables presented in the Federal Census publications, while "special-purpose" tables are constructed to show information in a concise form pertaining to a specific analysis. In dealing with the business man, the accountant takes into consideration what the person who uses the table desires in it. If the businessman has become accustomed to certain peculiarities in his table style, it is probably better to accommodate him rather than to construct the tables in the acceptable style. However, tabular construction of statistical data is somewhat similar to construction of accounting statements. While the form remains somewhat similar in all cases, the individual accountant may present his data differently if the case requires it.

Table construction. A table is composed of three major parts: the title, main body, and the footnotes. The title tells what the

Table contains, and a good title explains what is in the table without having to refer to the table's contents. However, since the accountant usually prepares "special-purpose" tables, it is not so necessary to have long titles with complete identification of the subject matter in the table. A short, concise statement of what, where, and when, in the order mentioned, is the necessary requisite of a good title. Usually the title is presented in a short phrase form rather than in complete sentences. Whenever there is more than one table in a report, each should be numbered.

The main body of the table is composed of columns and lines: The heading of a column is called a caption, and the explanation of a line is called a stub. The caption explains what the column represents, while the stub item explains what is represented in the line. Seldom does a general accountant have his tables printed, unless they are printed blanks on which he fills in the figures. The tables which he prepares usually are done on a typewriter or by hand; and unless he has an expert typist, the simpler the table the better chance of an excellent copy. Rulings are eliminated as much as possible, and wide and narrow spaces are used in place of rulings.

In the matter of arranging the material in the lines and columns, in most instances more of the items can be placed in the lines than can be arranged by columns. Items to be compared, whenever there are only a few, are usually placed in columns, as it is easier thus to make comparisons between items. In time series, the years are usually arranged in the lines and the comparisons

are made in the columns. Whenever comparisons are being made by means of a frequency distribution, or a table which shows the frequency of each class of item, the items are arranged in order of their sequence. The total frequencies may be placed at the bottom of the table, or, when the total is the most important part of the table, at the top below the captions. Other arrangements depend upon the method of classification. Data may be arranged alphabetically, by divisions, or by size, either in the rows or in the columns. Illustration VI shows data arranged chronologically in the lines.

If only a few figures are to be used and are part of a general discussion, in a report, the text may be broken and the data listed without being formally presented in a table. Many accounting reports are prepared in this method, since no reference is needed to the table, it being part of the text material in the report. An illustration of the method of incorporating the table as a part of the text is given on page 87, Chapter V.

Charts

Charts are not substitutes for statistical tables, but are additions to the tables for the interpretation of the figures. For every chart that is constructed there must also be a table from which to construct the chart, and in most instances presented with the chart. However, for a busy executive or for a person who wants a great deal of information at a glance, the chart has no equal.

Illustration VI

Employees and Payrolls of the General Motors Corporation and Fully Owned Subsidiaries*, 1921-1940

Year	Average Number of Employees	Total Payroll (000 omitted)
1921	45,965	\$ 66,020
1922	65,345	95,128
1923	91,265	138,291
1924	73,642	110,478
1925	83,278	136,747
1926	129,538	220,919
1927	175,666	302,905
1928	208,981	365,352
1929	233,286	389,518
1930	172,938	279,410
1931	157,586	236,520
1932	116,152	143,255
1933	137,764	171,184
1934	191,157	263,204
1935	211,712	327,678
1936	230,572	384,153
1937	261,977	460,452
1938	189,039	300,826
1939	220,434	386,292
1940	249,386	492,246

Source: General Motors Corporation, Thirty-Second Annual Report, p. 80.

*Includes Adam Opel A. G., Vauxhall Motors Ltd., Yellow Truck & Coach Manufacturing Company, and Fisher Body Corporation prior to the acquisition of the minority interest as of June 30, 1926.

Numerical relationships are sometimes hard to grasp, but anyone having an elementary knowledge of statistical methods can grasp the rudimentary meanings of a chart.

The main idea of charts is that two or more items are being compared, numerically. The type of graph which most aptly portrays the meaning of the figures depends upon the information which is to be presented and the person who is going to use the data. The major types of graphs are:

A. Bar Charts

1. Single bar charts
2. Component parts charts
3. The histogram
4. Pictogram

B. Line Charts

- a. Frequency polygon
- b. Time series charts
 - (1) Arithmetic chart
 - (2) Semilogarithmic chart

C. Area Charts

1. Pie charts

Bar Charts

Probably the most common of all methods of graphically showing simple comparisons is by the bar chart. In time series only the vertical bar is used, but in other comparisons of size, either the

Vertical or horizontal bar may be used. Chart I illustrates a horizontal bar chart showing the percentage of the various assets of the American Mutual Life Insurance Company in 1939, as given in Illustration VII. Whenever the classification is other than time, the bar may be either vertical or horizontal. Chart II is a bar chart showing the distribution of the assets of the Jones Manufacturing Company as computed in Chapter V, dealing with the percentage analysis of financial statements. It is possible to use guide lines in a bar chart or, if the chart is easy to read, the guide lines may be omitted. However, it is not good form to omit either the vertical or horizontal scale. Some accountants have made a practice of comparing two items by the length of the vertical bars without a vertical scale. Such practice is not appropriate because erroneous impressions may be given, which may ultimately lead to misgivings as to the worth of any type of statistical analysis of a company.

Many times it is desirable to show comparisons of one or more items to the total of all of the items in one bar. The length of the bar is equal to 100% and is divided into proportionate parts for each item represented. Chart III illustrates the component parts chart with one bar representing the total assets; one, the total liabilities; and the third, the total capital. When comparisons are made between different bars, it is important to remember that percentages are being compared rather than exact figures. The current assets are a greater proportion of the total assets

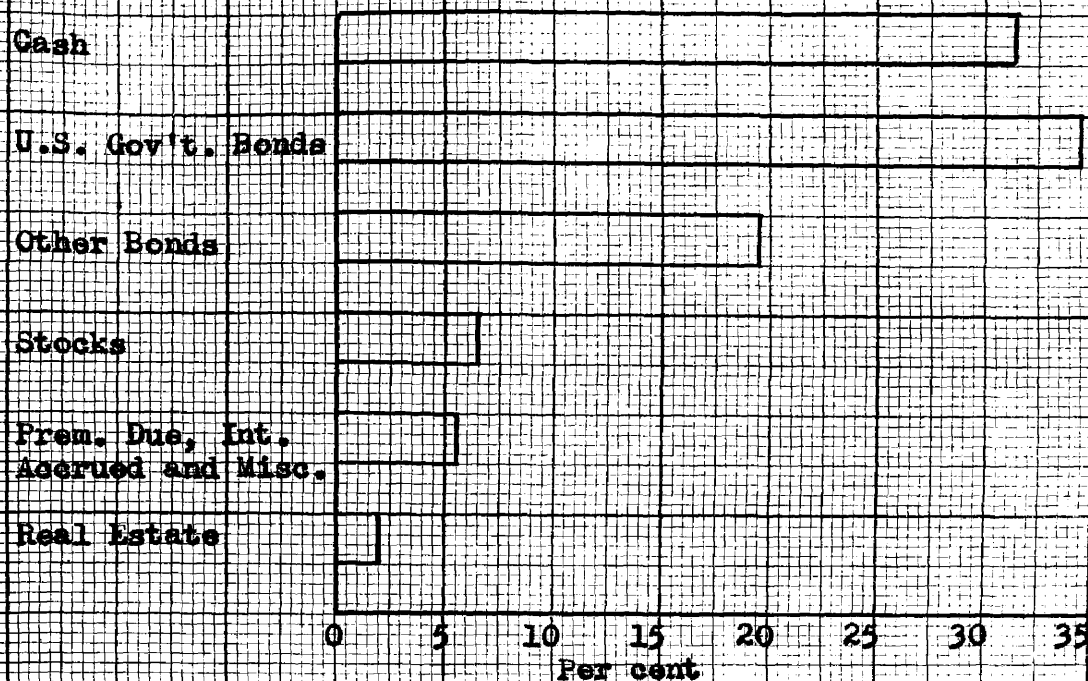


Chart I. Percentage Distribution of Assets, American Mutual Life Insurance Co. 1939. (Source: 1939 Annual Report).

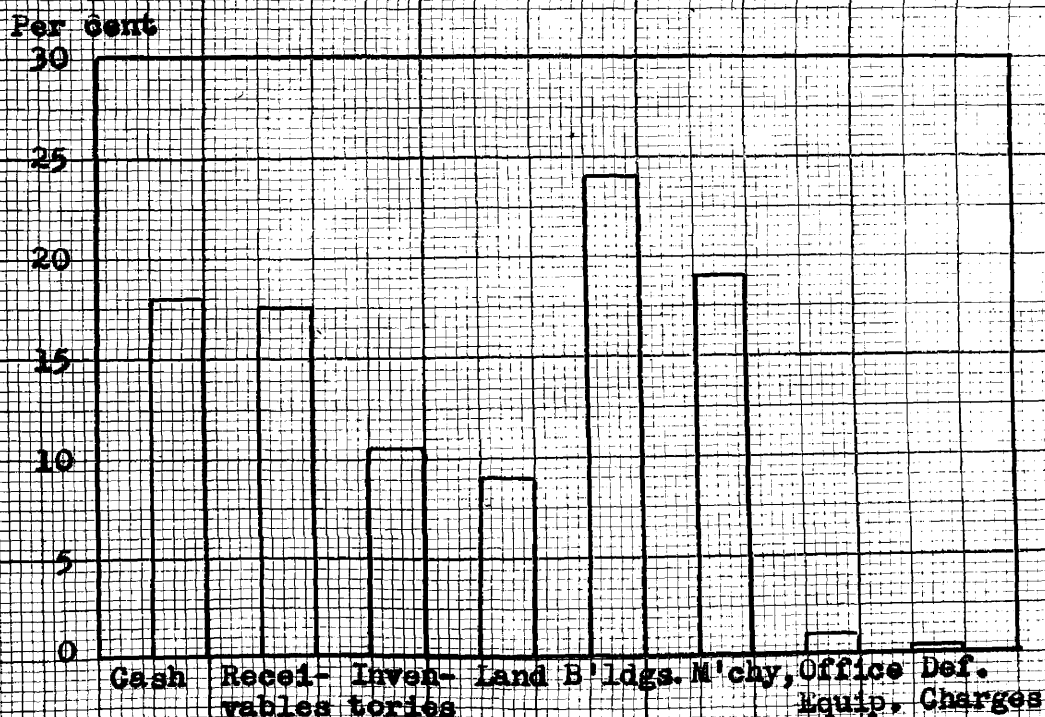


Chart II. Percentage Distribution of the Assets of the Jones Manufacturing Co. (Source: See Illustration I).

Illustration VII

Distribution of Assets, American Mutual Life Insurance Co.
1939 Percentage

Asset	Percent of Total Assets
Cash	31.54
U. S. Government Bonds	34.67
Other Bonds	19.63
Stocks	6.85
Premiums Due, Interest Accrued and Misc.	5.56
Real Estate	1.75
Mortgages and Loans	<u>.00</u>
Total Percent	100.00

Source: Annual Report for 1939, American Mutual Life Insurance Company.

than current liabilities are of the total liabilities, in Chart III, but no idea of the total of the assets or the liabilities can be derived from the above chart.

Whenever many items are classified into various frequencies and a bar chart is constructed from the results, a histogram is derived. Instead of leaving a space between the bars as is done in the bar chart, the bars are usually placed together. Chart IV is a histogram of the ages of employees of an assumed company.

In all of the illustrations of bar charts presented, the title

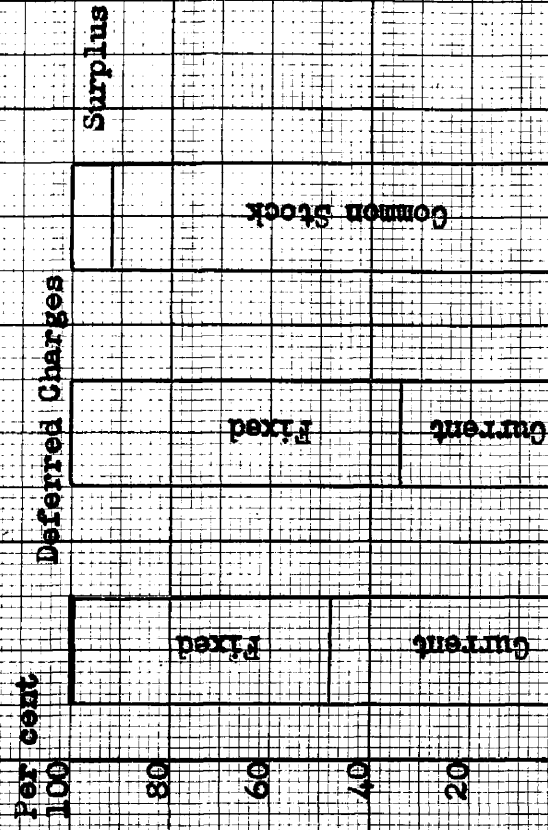


Chart III. Distribution of Assets, Liabilities and Capital of the Jones Manufacturing Co. (Source: See Illustration I).

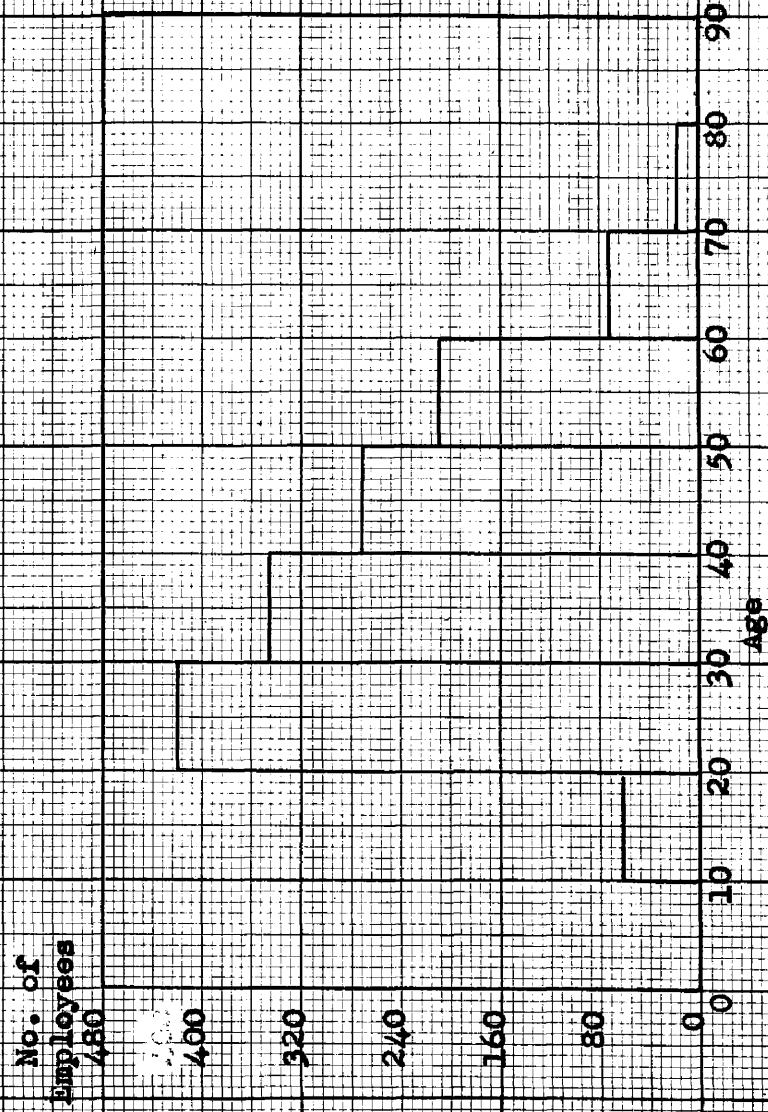


Chart IV. Age Groups of the Employees of an Assumed Manufacturing Co. (Histogram).

of the chart is at the bottom of the chart. Most authorities recommended placing the title at the bottom of the chart, but in many instances placing the title at the top is just as appropriate. The heading of the vertical scale may be placed either at the side of the column or at the top. Usually, however, all reading is horizontal when possible.

Another type of bar chart which is probably the most fascinating of any of the types is the pictogram. The bar is composed of numerous symbols representing the products being compared. For example, in Chart I each symbol may represent five per cent. The symbol for cash may be a stack of silver dollars; the symbol for government bonds may be a folded bond with the picture of Uncle Sam, while other bonds may be represented by a symbol of a folded bond with a factory on it, likewise with all of the other items. When constructing pictograms it is necessary to have an excellent artist to construct the symbols. Strips of symbols may sometimes be purchased, however, in case no artist is available.

Line Charts

Often lines are drawn between the midpoints of the tops of the bars of a histogram. When this is done, the lines form a frequency polygon. The frequency polygon contains the same area as is contained under the bars of the histogram. Rather than construct a curve connecting the bars of the histogram, usually either the frequency polygon or the histogram is constructed separately. Chart V

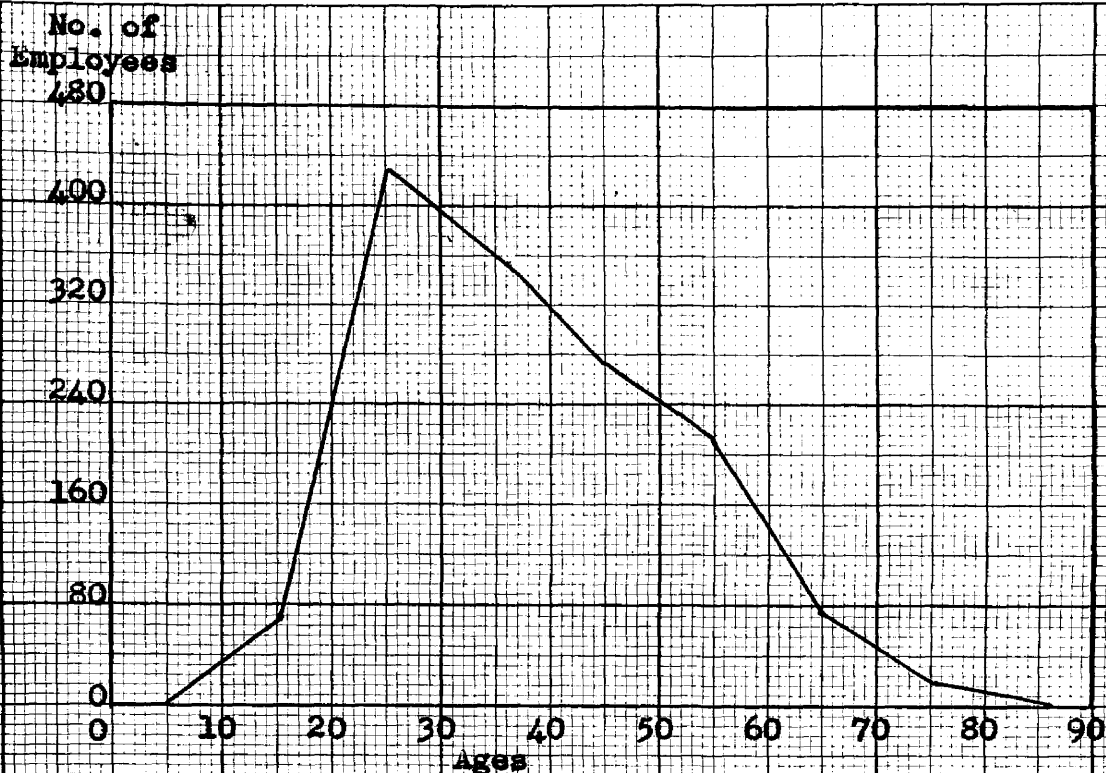


Chart V. Age Groups of the Employees of an Assumed Manufacturing Co. (Frequency Polygon).

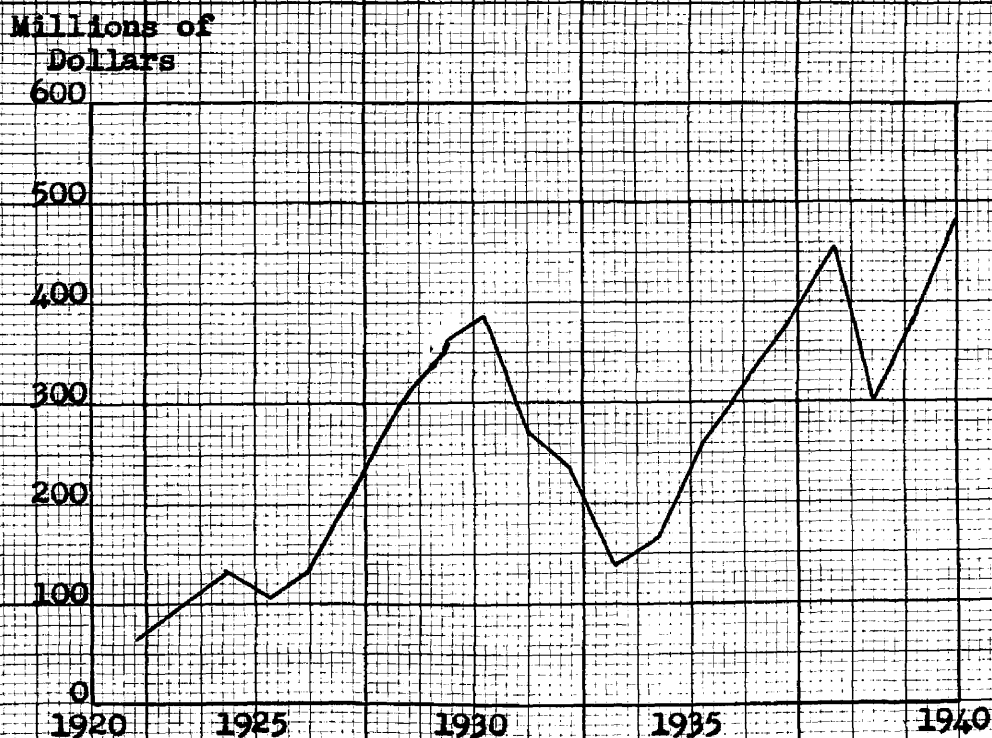


Chart VI. Total Payroll of General Motors Corporation, 1921-1940. (Source: General Motors Corporation. Thirty Second Annual Report, 1940)

is a frequency polygon constructed from the data which is contained in Chart IV, one however being a line chart while the other being constructed of bars.

Many times a frequency distribution is made of data which is not continuous from one classification to the next. When a distribution of this type is made, it is not proper to construct a line diagram of the data, since connecting lines are supposed to show continuity. When constructing a frequency polygon, the curve should connect with the zero or base line at both ends of the curve.

The greater percentage of the curves which an accountant constructs is done from the major classification of time. Time series charts are two kinds: the arithmetic and the semi-logarithmic. Chart VI is a curve of the total payrolls of the General Motors Corporation from 1921 to 1940.

The mechanics of constructing a chart cannot be outlined in the form of objective rules. The proportion should be such that gross impressions are not received from the chart. One of the easiest methods of overcoming any attempt to use misleading scales is to make the chart almost equal in length and depth and to adjust the scale to fit the measurements. This method does not always give a proportionate chart, but is one of the simplest rules to follow. Whenever the base is zero, the zero should be shown on the chart

unless obvious methods are employed to show that a break in the scale has been made. Guide lines which are very light compared to the curve line are usually employed on printed charts but are not necessary on some coordinate paper. Since the accountant prepares charts for use within the organization, coordinate paper is employed more often than the more finely drawn charts. When guide lines are drawn, no more of them should be used than necessary to guide the eye for proper perspective. Too many lines detract from the appearance of the chart, while too few lines are a hindrance in the proper reading of the chart. When guide lines are not employed, it is proper to place guide marks on the vertical and horizontal scales.

Index line charts are somewhat similar to the preceding charts with the exception of the base line. Since one hundred per cent is the base in an index chart, it is not necessary to carry the scale to zero. Since the line representing 100 per cent is the base, it should be heavier than the other guide lines to show the distinction. Chart VII shows the index of business activity in Louisiana from 1937 to 1943. What the base line of 100 per cent represents is very important and should be represented on the chart. On Chart VII the average month of 1937-39 = 100, and this is placed in the lower right hand corner of the chart.

Whenever the rate of growth of a statistical series or a group of series is desired, the semi-logarithmic chart may be constructed. If the rate of growth of a series remains constant from year to year, the line which is plotted on an arithmetic chart would be a curve

INDEX OF LOUISIANA BUSINESS ACTIVITY

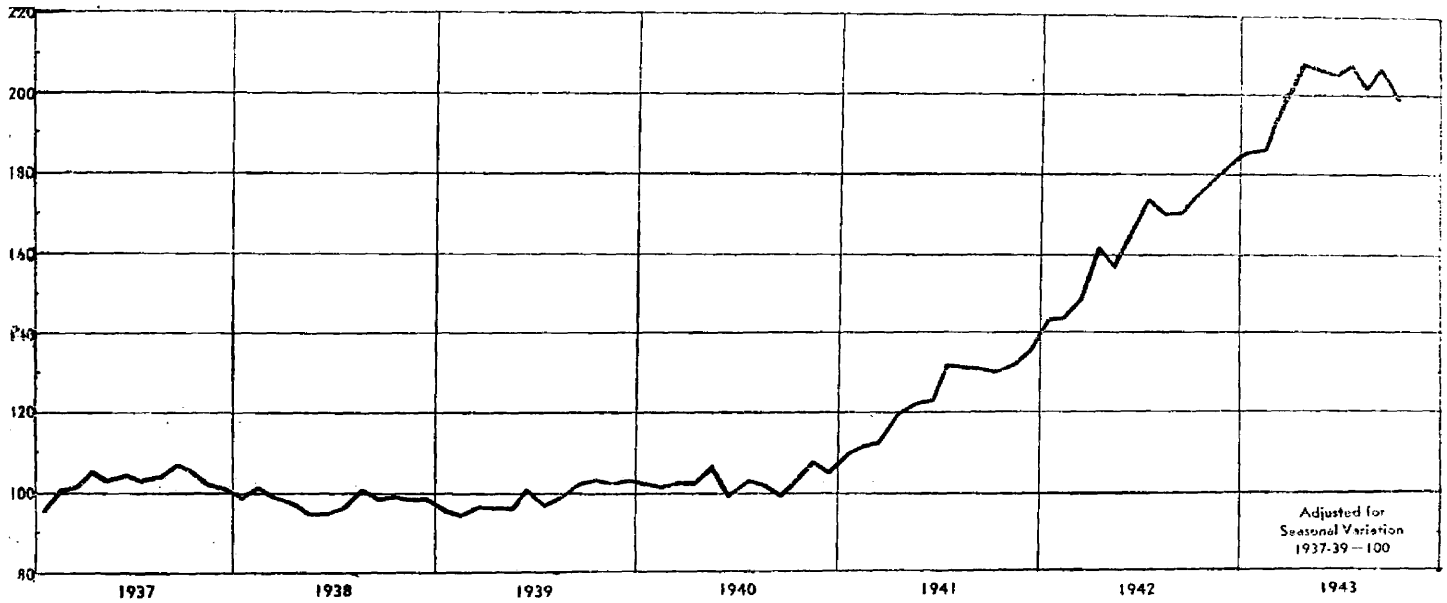


Chart VII.

sloping upward. On a semi-logarithmic chart the line would be a straight line.

The horizontal scale on semi-logarithmic paper is the same as on arithmetic paper, that is, the intervals are the same distance apart. The vertical scale, however, represents the logarithms of the numbers from one to ten on a single cycle paper. Multiple cycle paper may be obtained, and the first line in a cycle is always ten times the value of the first line in the preceding cycle. As such, the space between one and two is the same distance as the space between two and four, or eight and sixteen. The same ratio, $1/2$, $2/4$, $4/8$, $3/6$, or $8/16$, is represented by the same distance on the vertical scale, while the arithmetic progressions vary as to space required.

Since there is no zero on the vertical scale of the semi-logarithmic chart, and any similar ratio on the vertical scale is the same distance apart, any two or more series can be plotted on this type of chart and brought close together for comparison. Chart VIII shows the Gross Revenues from the sale of Electric Power of the New Orleans Public Service, Inc. compared with the total sales of electric power in the United States, as computed by the Electric Power Institute. The vertical scale on the left is in terms of the New Orleans Public Service, Inc., while that on the right is for the United States. The amounts being compared are widely different, but the rate of growth or decline in each case is fairly constant. However, in the last two or three years, the

N.O. Public Service
(Millions of Dollars)

U. S.
(Millions of Dollars)

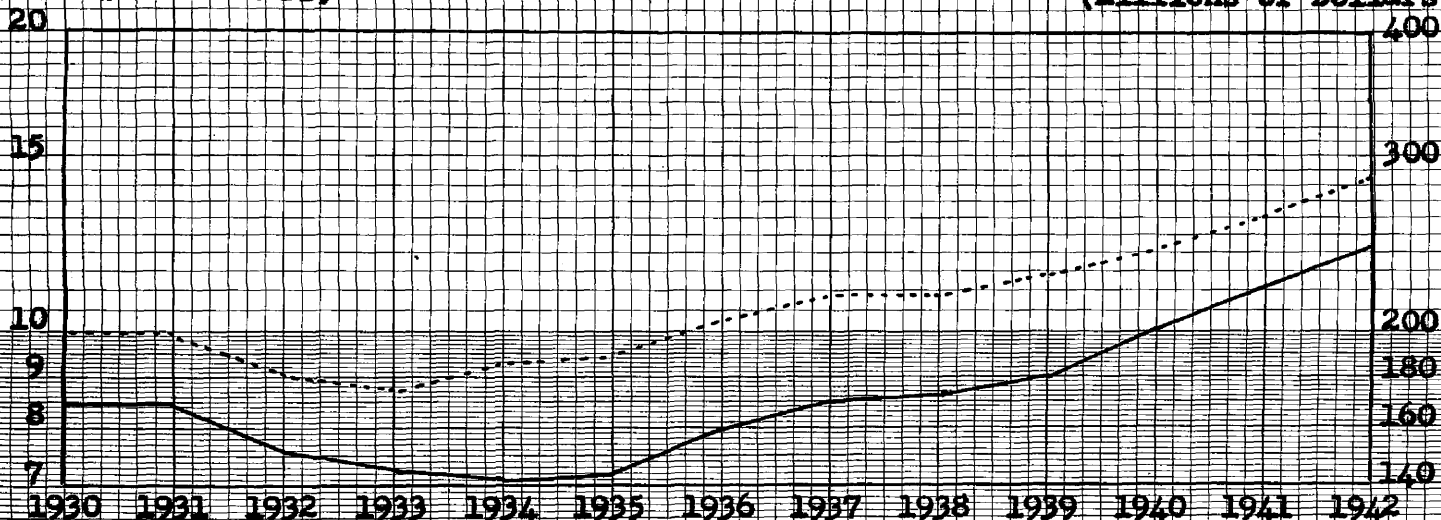


Chart VIII. Gross Revenues From Sales of Electric Power of New Orleans Public Service, Inc., and U. S. (Source: N. O. Public Service, Annual Reports and McGraw-Hill; U. S., Survey of Current Business from Electric Power Institute.)

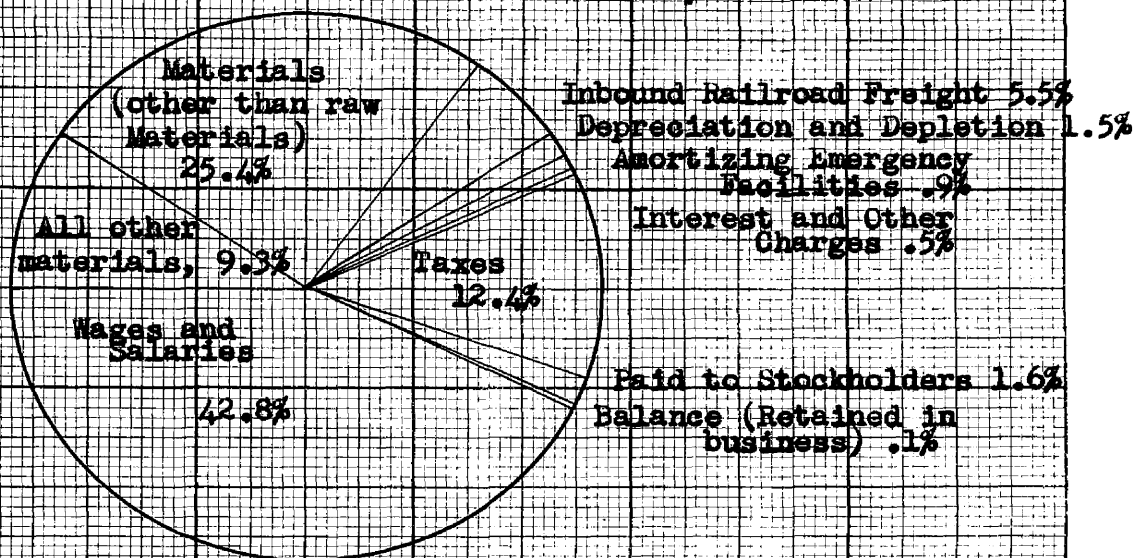


Chart IX. Distribution of Bethlehem's Steel's 1942 Receipts--Received in Exchange for goods and services, \$1, 511, 672, 299. (Source: Bethlehem Review, Mar. 1943.)

sales of Electric Power for the New Orleans Public Service, Inc., have been increasing at a greater rate than has the sales of electric power in the United States as a whole.

Area Charts

The most important of the types of statistical charts which portray comparisons by the area covered is the pie chart, so named because it is a circle broken down into various sections. Chart IX illustrates the principle of the pie chart. The pie chart is constructed on the same principle as the component parts bar chart--the total area equals 100%. In accounting work, any comparisons between various parts and a total may be made through a pie chart. The comparison which is computed by most concerns is the relation of the expenses to net sales. In Chart IX is shown by means of a pie diagram what has happened to the income from goods and services of the Bethlehem Steel Company for 1942.

CHAPTER IX

STATISTICAL METHODS FOR THE PUBLIC ACCOUNTANT

The Public Accountant is in a fortunate position in the use of statistical methods in analyzing the data of his clients. He usually has access to all of the information which the company accountant has; in addition he has viewpoints which come about through the analysis of like companies in the same industry.

Harry M. Wade makes the following statement regarding the use of statistics by the public accountant.

Upon inspection it appears that the public accountant is in an advantageous position in reference to the utilization of statistics in his practice. Files of audit reports contain a rich mine of statistical data which might be used with great advantage to the client and without violation of confidence. Furthermore, the accountant is adapted to the intelligent compilation of the data so as to produce significant results. Public accountants tending to specialize in the field of one particular industry become a depository of detailed and trustworthy data which perhaps might yield valuable information, under statistical treatment, concerning conditions past, present, and future, in that industry. Somewhat the same type of statistical treatment might also be advantageously applied to the figures of one concern within the industry. The public accountant has also the usual outside sources of statistical data which could be used in a supplementary manner. The computation of seasonals, secular trends, cycles, correlations, and index numbers would certainly facilitate the intelligent interpretation of the accounting statements and records.

Perhaps the public accountant does not wish to increase his already numerous duties and responsibilities. It appears, however, that the public accountant is being placed in the position of business adviser more and more each year and he must face the problem of equipping himself to render this new service or acknowledge his inability, or lack of desire, to do so. Regardless of this phase of the question there are many situations wherein close association exists between orthodox accounting practice and statistics.⁷¹

All of the preceding statistical methods which have been described for the use of general accountants may be applied by the public accountant. Averages and percentages express relationships between variables in a simpler form than if all of the numbers are included. Seasonal indexes, trends, and cycles compare variations between different time periods. In addition to the statistical methods already mentioned various ways of test checking for inventories, receivables, payables, postings, footings, and vouchings of checks, invoices, and other documents by means of sampling techniques help to save much work for the auditor.

The auditor, through the use of the various ratios and percentages which have been derived as a result of past operations or by comparison with other industries of the same type, has one of his most useful tools in the analysis of inventories. Montgomery makes the following statement:

When several factories are producing similar goods, the quantity of raw materials on hand at each of the several factories may be compared with reported current consumption. Usually the established policy

⁷¹Harry H. Wade, "Statistics and the Accountant," *Journal of Accountancy*, Vol. 51, January, 1931, p. 34.

will limit raw material inventories to a quantity representing a certain period's normal consumption, and if an excess is shown question should immediately arise. Comparison of operating statistics of the factories may point to unusual conditions, which when investigated may lead to discovery of an error in the inventory figures.

Unless abnormal conditions make the test worthless, the auditor should attempt to check the aggregate of the inventory by the "gross profit test," that is, to compare the percentage of the gross profit with that of previous years. In a business in which the average gross profit remains fairly constant, this test is trustworthy. If the rate of gross profit has risen or fallen and the discrepancy cannot be satisfactorily accounted for by a rise or fall in the cost of production or in the selling price, the cause of difference is usually due to errors in stocktaking or to improper valuation.

A variant of the same test is a comparison of the cost of sales for the past year (or shorter period) with the inventory. If the turnover has not been normal, it may indicate an accumulation of unsalable goods. Some business men dislike to sell below cost and would rather permit a large stock of old goods to accumulate than dispose of the old and obsolete stock at a sacrifice. The usual outcome is that the stock becomes unwieldy and funds are lacking to purchase new goods. In general, the question which should be considered before deciding on the inventory as a whole is whether the inventory is in proper ratio to the volume of business done. If possible, the same question should be taken up with reference to the various sections of the inventory.⁷²

In dealing with income tax procedures the public accountant, through the use of ratios, proportions and percentages, can be very helpful to the client in determining the probable amount of income tax which is payable to either the state or federal authorities, or to both.

⁷²Robert H. Montgomery, *Auditing Theory and Practice*, Sixth Edition, The Ronald Press Company, New York, 1940, p. 139.

Under abnormal conditions it would take more than a prophet to absolutely foresee the correct amount of tax on the income which is earned. When a company keeps its records on a monthly basis, a certain percentage of the earned income should be provided for future payments of the tax liability. The percentage which is used will depend upon the amount of yearly net profit as well as on the income tax rates in effect during that time. Although the current tax laws require that only individuals estimate and pay income tax on a current basis, the time may come when corporations will have to estimate the income tax and pay it as well as set aside a reserve account until the end of the year.

The problem of calculating the amount of income tax payable when a company has both state and federal taxes to pay under the accrual system becomes a problem of mathematical methods; and while the procedure for determining the tax when both taxes and a bonus are included becomes more complicated, the procedure is similar. A description of methods of computing the tax and the bonus is available in any good textbook on business mathematics; and in addition, recent articles on the subject have been printed in periodicals for use by accountants. The three methods used are the "algebraic" or "linear equation,"⁷³ successive trials, and the "attrition method."⁷⁴ In the algebraic solution, the number of

⁷³For a complete discussion of the use of linear equations see L. W. Coleman, Jr., "The Use of Determinants in the Solution of Linear Equations," *The Accounting Review*, January, 1943, pp. 44-48.

⁷⁴For a complete discussion of the "Attrition Method" see W. B. Castenholz, "Why Not 'Attrition'?" *The Journal of Accountancy*, Oct., 1942, pp. 341-91.

equations which are developed are the same as the number of unknowns and are then solved by the process known as simultaneous equations. In the "attrition method," the process is to determine by successive "rubbing off" the amount of tax and bonus. While the "attrition method" and the successive trials method differ, they are somewhat similar in their characteristics. Successive trials is a matter of trial and error until the correct solution is reached.

Sampling or Test Checking

Whenever an accountant is making an investigation, the possibility exists of checking all items in the examination. However, in most instances, it is not necessary to collect complete information on the problem, or, as the statisticians say, "use the 'universe' of the data." Especially is this true in the analysis of inventories and receivables.

To overcome the difficulties of checking each item in every investigation, the method of sampling has come into use. The Encyclopedia of Social Science has the following to say relative to statistical theory and sampling:

It is clear that one of the main tasks of statistical theory is to devise methods for inferring from comparatively small numbers of observations conclusions as to larger universes of which the observation in question forms a part or a derivative. These larger universes may comprise an infinite number of units (open universes), a finite but very large number or only a limited number. If the number of units drawn into the sample is large in relation to the total number of units in the universe, then regardless of the method used in selecting the sample, it is not difficult to ascertain the highest arithmetically possible

limits of deviation of the characteristics of the sample from those of the universe. In all other cases only special rules of sampling will secure satisfactory results.⁷⁵

Sampling theory is basically related to both the theory of probability and the theory of errors. When a simple sample is taken, or when each of the different items has the same probability of being chosen as any of the other items, the relationship can be worked out to a precise mathematical point. The working out of mathematical relationships was done in games of chance long before the idea of using samples in statistical analysis instead of exhaustive enumeration was considered practical. Today, however, sampling with approximate results is adequate for all practical purposes and the time consuming and costly exhaustive enumeration is used for all practical purposes only in necessary cases where the costs are small in relation to the benefits received.

If the probability of each item in the problem remains in equal proportions to all other items, the method of random sampling may be used. Few types of social and business data are of this type, however, since the data are continuous in character and the problem of breaking the continuous data up so that they may be used in business or social studies becomes acute if only the random method of sampling is used. This does not mean that business studies cannot use the method of random sampling, but only that there are

⁷⁵Encyclopedia of the Social Sciences, "Statistics," The Macmillan Company, New York, 1937, p. 368.

technical difficulties in gathering a sample which is adequate and representative when only the random method is used.

Whenever heterogeneous units are used as the data for the statistical study, the method of stratified sampling is used. "A stratified sample differs from a random sample in that the population is broken into subgroups or strata before the sample is drawn. A random sample is then taken from each stratum."⁷⁶

When certain characteristics of the population are already known, the sample may be made to agree with the known facts. When the sample is selected by design, it is often called "purposive."⁷⁷

The theory behind sampling supposes that a small number of items will show the same characteristics as the total of the items of the universe. The truth of this fact is evident only when certain basic rules and procedures have been followed when the sample is taken. The major considerations of any sample are:

1. The sample must be representative.
2. The sample must be adequate.
3. The sample must show stability.

Other considerations which must be heeded are: the relevancy of the sample to the problem, the use of homogeneous data in the sample, and the accuracy of the work in gathering and compiling the sample.

A sample is representative when it shows the same characteristics as the data in the universe. Day says:

⁷⁶Frederick E. Croxton and Dudley J. Cowden, Applied General Statistics, Prentice-Hall, Inc., New York, 1939, p. 27-28.

⁷⁷Ibid., pp. 28-29.

Adequacy is another consideration to be kept in mind in interpreting statistical data. Data may conform to all the requirements of logical consistency and homogeneity and still be inconclusive because lacking in representativeness. When the data are complete they may lack representativeness owing to the limitations in the universe represented; when the data are only partial they may fail to support inferences because of the inadequacy of the sample. Many statistical conclusions rest upon "foundations of sand" simply because the underlying data are not thoroughly representative.

The consideration of adequacy is especially important in connection with sampling. According to Bowley, the essentials of the sampling method are: (1) "every unit in the district or class dealt with must have approximately the same chance of inclusion"; (2) selection must deliberately be made at random." Care must be exercised not to select unduly from among the more obvious and accessible cases. Precautions must also be taken to avoid disproportionate representation of particular types. Thus, questionnaire returns may give an undue representation of the more intelligent and conscientious informants. Adequacy of sampling increases rapidly with the number of cases included. In general, the simplest practicable rule to observe is to increase the size of the sample until successive samples give approximately the same result.⁷⁸

Concerning stability Day says:

Closely connected with the question of adequacy is the question of stability. Are there reasons for believing that the results exhibited in the data will be repeated in later investigations? Fortunately, statistical results which depend upon large masses of individuals show an extraordinary degree of regularity. Large numbers are said to exhibit inertia. There is surprising uniformity, for example, in certain statistical coefficients under widely different conditions; such coefficients, for example, as the suicide rate, or the mean expectancy of life. Were it not for this stability in statistical results, statistical investigation would hardly be worth while. It is because

⁷⁸Edmund K. Day, Statistical Analysis, The Macmillan Company, New York, 1930, pp. 376-377.

underlying laws or tendencies are discernible that statistical results merit the careful attention they are given.⁷⁹

There are limitations on the use of the sample in accounting investigations, however. These limitations may be due to the data themselves or to the one who takes the sample. For example, a sample may be biased either as to the person who takes it or by the sample itself having a bias which is not readily visible; or it may include both types of bias. The observation may be taken from the most available data instead of obtaining the data which is representative. Sampling is, however, one of the best available means for obtaining practical results of a large amount of numerical data in the shortest possible time at the least expenditure of money and effort.

Conditions of sampling, especially in the business or social field, rarely approach the theoretically perfect state in which samples show exact results. However, it is not necessary to have theoretical perfection to obtain benefits from a sample, since a sample which is adequate and representative will give results which are applicable in most practical situations.

Two major types of problems are involved in practical sampling: (1) What data are necessary for the study, and how large a sample is necessary to determine if the data will show what is needed? This, of course, means what is the minimum num-

⁷⁹*Ibid.*, p. 377.

ber necessary for the observation, or the amount above which one need not go to get dependable results. (2) How is it possible to determine if the sample is adequate and representative?

There are many cases in accounting-statistical analysis where it is possible to use all of the information available and still have insufficient data to arrive at a correct solution to the problem. Lack of adequate data is often the case when only accounting records are used as sources of information. In testing inventories and receivables, the data are usually drawn from a small group of representative parts of the entire field. The problem of determining when the sample is too small, or how many observations are absolutely necessary, comes under the heading of forecasting. The problem of forecasting the size of a sample, unless the problem has been done many times before, usually is a matter of personal judgment. The American Marketing Association makes this statement about the size of a sample:

In the absence of an absolute index, the practice has been--and largely still is--arbitrarily to set a figure which represents what the research director believes sufficient in the light of his own experience with the same or similar studies or of the corresponding experience of other research men. As the work proceeds, the sufficiency of the sample may be checked by the diminishing range of divergences as determined by the standard deviation or probable error.⁸⁰

When the same type of audit has been worked on before, it is possible to use statistical measures computed from these data to

⁸⁰American Marketing Association, The Technique of Marketing Research, McGraw-Hill Book Company, Inc., New York, 1937, p. 54.

forecast more accurately the number of observations to take, the standard deviation and the probable error being the two most widely used mathematical methods.

The amount of time and money saved through accurately predetermining the number of observations is easily recognizable. To underestimate the number in the sample is a worse mistake than to overestimate it. When the number is overestimated, the data can be used; while if underestimated, the material is valueless for the statistical study, and may prove embarrassing to the auditing firm.

After the results from sampling begin to come in, it is possible from these results to determine if any stability exists in the answers to the questions. Probably the most familiar and often used method of determining when the answers begin to become stable is by separating the returns into random groups. When, through the addition of more returns added to each group, the answers in each group tend to remain the same percentage of the total of the group, stability may be said to exist.

Methods have been devised mathematically to determine the size of the sample also. Theodore H. Brown of Harvard has devised a table showing the size of the sample when the known percentage of permissible error is available. Several limitations exist in this type of table, however, since it works on the principle of probability and many social samples do not conform entirely to the laws of probability.

As has been mentioned, the size of the sample, among other

things, determines the cost. Size is no criterion of value, however. The Literary Digest Poll of 1936 was large but contained so much error that it was worthless. In accordance with the above principle, the sub-samples must stand alone and must not be dependent upon the major sample. The major sample may be large but not contain relevant data or sufficient data for the sub-sample. The size of the sample is determined by the amount of allowable error in the sample.

In sampling, difficulties exist to a greater extent in business or social data than in physical data. Human limitations exist in the sampling of this type of data. Instead of just taking a random sample, it is usually better to break the sample down into sub-groups, of which something of the universe is known, and then take a random sample of this "Stratified Sample." "Stratified Sampling" is done so that a correct proportion of the universe will be taken and is known as obtaining "proportionality in the sample."

L. O. Brown says: " . . . it was shown that an adequate sample has two characteristics: (1) reliability, and (2) proportionality. In planning a sample every effort is made to obtain both of these characteristics."⁸¹ Problems of finding the reliability and proportionality of the sample and remedying any obvious defects may be major considerations.

⁸¹Lyndon O. Brown, Market Research and Analysis, The Ronald Press Company, New York, 1937, p. 310.

Application of Sampling Technique by Auditors

Unless an engagement is very small, or a need exists for very great accuracy, time and expense do not allow the auditor to determine with certainty that the transactions and accounts are absolutely correct. Thus, the auditor is dealing with a situation in which he wishes to be certain that the chances are very high that he has not overlooked an error. As has been stated in the above section on the theory of sampling, it is usually up to the person making the audit to determine which section of the audit may contain the most errors and the number of possible errors in that section.

In an audit testing by sampling involves the separation of items into homogeneous groups. That is, the representativeness of the sample cannot be determined very well if one is testing types of inventories and footings of the inventory sheets in the same sample. The major groups to be tested fall under the following heads: accounts receivable balances, accounts payable balances, inventory types, inventory footings, purchase vouchers, cash disbursements, payrolls, cashbook postings, and voucher register footings. Whether the items should be tested completely or only in part depends upon the possibility of error existing in each of the various classifications. The amount of error which can be determined readily depends upon the amount of internal control and the experience of the auditor.

When sampling, or test-checking (as it is called by auditors), during an audit, the auditor tries to determine if there are errors

in the books without analyzing each transaction. If there are no errors, the auditor can certify the company's statements without taking the time necessary to go through the company's books. However, neither he nor the company know how many errors there are in the records and for that reason he has been called to audit the books and give an independent opinion that the records are kept accurately. When an auditor needs to make detailed analysis of every transaction, costs run very high in the large concerns. If the auditor can convince himself that chance for error is slight, it is not necessary to scan every transaction.

Sampling techniques in auditing are employed to determine the probability of locating errors in the records. When there are only two items to be tested, and one of them has an error in it, there is a fifty-fifty chance that the error will be detected if only one item is investigated. Stated differently, there is one chance in two that the error will be located. When there are a hundred items and only one error, if only one item is investigated, there is a small chance that the error will be found, that is, one chance in a hundred. Likewise, if there are a hundred items and two errors, there is one chance in fifty that one of the errors will be located, if one item of the total is investigated. The above conditions are true only if the item that is being investigated is selected on a random basis. If the person knows that there were a hundred items to be investigated and he also knows that the error is located in a group of ten items, then when he selects one

of the ten, his chances of locating the error is one in ten rather than one in a hundred. When an auditor selects footings by months rather than by the number of footings, he is violating the principle of random selection, since he is not selecting a group of random items to be checked. The probability of finding one error in a year's footings is much greater when one-third of the footings are tested than when footings for four separate months are tested. The same principle is true in testing accounts receivable. When there are 3,000 items, it is better in a 10% sample to select every tenth account than to select the accounts under A, the accounts under H, and the accounts under K, which constitute approximately ten per cent of the total.

The first problem, then, in test checking in an audit is to determine the possible errors located in each of the different items to be tested. How many errors are likely to exist in the accounts receivable? How many errors are possible in the voucher register footings; the purchase vouchers; the cash disbursements; or any of the other items to be tested? When the expected number of errors is determined, then to reasonably expect to find one of these errors, the following table may be employed as a guide in the size of the sample to take:⁸²

⁸²The following table was taken from Robert H. Frytharch, "How Much Test Checking is Enough," *The Journal of Accountancy*, Vol. 74, No. 6, Dec., 1942, pp. 525-530. The original material from which the table was formed is found in Lewis A. Carman, "The Efficacy of Tests, Test-Checking Subjected to Mathematical Analysis--Constructive Article on New Subject," *The American Accountant*, Dec., 1933, pp. 360-366. The preceding two articles are probably the best technical articles on test-checking which have been written in the last ten years.

Assumed number of False Items in Group	Most Economical Random Sample (Approximately)	Probability of En- countering at least one false item (approx.)
Over 40	8%	Over 95%
Over 30	10	Over 95
" 20	15	" 95
" 15	20	" 95
" 10	22	" 90
" 9	24	" 90
" 8	26	" 90
" 7	28	" 90
" 6	30	" 85
" 5	35	" 85
" 4	40	" 85
" 3	45	" 85
" 2	50	" 75

If no errors are found in the sample, the probability is high that there are no errors in the type of item being tested. The preceding table is computed by determining the area under the normal curve, and may reasonably be expected to be accurate when the items being tested form a normal distribution. Usually, in testing inventories or accounts receivable or payable, the very large accounts are separated and examined thoroughly, while the smaller accounts are test-checked. This method eliminates any possibility of a gross error being overlooked.

While test-checking by public-accountants is a recognized method, very little theoretical specialized work has been done by public accountants in the field of sampling.

CHAPTER X

STATISTICAL METHODS FOR PUBLIC ACCOUNTANTS, CONTINUED

Statistical Presentation of Accounting Data

New Type Accounting Statements

Within recent years accountants have been getting away from an all purpose statement. The general accounting statements--the balance sheet and the profit and loss statement--have not been eliminated but they have a specific purpose. New type balance sheet and profit and loss statements are being prepared for stockholders, employees, and the general public who are not fully acquainted with the common accounting statements. The methods of arranging the items in the explanatory type statements are very much similar to the regular statements, but less detail and more explanation accompanies the statement. Cudahy Packing Company in their 1942 annual report attempted to show changes as represented on the balance sheets for the years 1941 and 1942. The following statement, Illustration VIII, is an expansion of the statement of application of funds for explanatory purposes:

Illustration VIII
BALANCE SHEET⁸³

The following comparative balance sheets as of October 31, 1941 and 1942 set forth the principal changes in working capital, other assets and liabilities during the year:

	<u>October 31</u>		Increase or Decrease
	<u>1941</u>	<u>1942</u>	
WORKING CAPITAL			
Current Assets:			
Cash	\$ 3,108,360	\$ 5,037,848	\$1,929,488
Accounts receivable, less reserves	13,121,215	15,916,605	2,795,390
Inventories	<u>22,673,427</u>	<u>26,378,933</u>	<u>3,705,506</u>
Total current assets	<u>\$38,903,002</u>	<u>\$47,333,386</u>	<u>\$8,430,384</u>
Current Liabilities:			
Notes payable	\$ 6,207,500	\$11,458,500	\$5,251,000
Accounts payable	2,795,037	3,164,842	369,805
Accrued liabilities	1,172,079	1,666,172	494,093
Employees' pension reserve	— —	550,000	550,000
Reserves for income taxes (Less \$3,000,000 U.S. Treasury Tax Notes at Oct. 31, 1942)	1,398,811	1,124,384	274,427
Sinking fund payments due within one year	<u>425,500</u>	<u>350,000</u>	<u>75,500</u>
Total current liabilities	<u>\$11,998,927</u>	<u>\$18,313,898</u>	<u>\$6,314,971</u>
Net working capital	<u>\$26,904,075</u>	<u>\$29,019,488</u>	<u>\$2,115,413</u>
OTHER ASSETS:			
Investments	556,527	355,786	200,741
Fixed assets less depreciation reserves	24,567,144	23,929,576	637,568
Prepaid and deferred charges	<u>927,328</u>	<u>1,105,785</u>	<u>158,457</u>
Total	<u>\$52,975,074</u>	<u>\$54,410,635</u>	<u>\$1,435,561</u>
REPRESENTED BY:			
Long-term debt	\$21,895,000	\$21,402,500	\$ 492,500
Reserve for post-war adjustments	— —	1,000,000	1,000,000
Minority interest in subsidiary	74,373	77,007	2,634
Capital stock and surplus	<u>31,005,701</u>	<u>31,931,128</u>	<u>925,427</u>
Total, as above	<u>\$52,975,074</u>	<u>\$54,410,635</u>	<u>\$1,435,561</u>

⁸³Annual Report, Gudeby Packing Company, 1942.

are only sufficient for about 190
month's average operation

While the majority of annual reports to stockholders still present the regular balance sheet and profit and loss statements, they are accompanied by explanatory statements for use by the general public. Borden's Annual Report for 1942 presents in addition to the regular statements the following statements, Illustration IX and X:

Illustration IX

HOW WE STOOD ON DECEMBER 31, 1942⁸⁴

The Balance Sheet at the end of the year is a statement which shows what is Owned and what is Owed,--the difference representing Net Worth. This statement is shown below in a descriptive manner. The values have been divided by the average number of employees (27,216) to show the investment per employee.

		Investment per Employee
WE OWNED (ASSETS)		
payroll, supplies, freight		
CASH -- In banks and on hand available to pay for milk, payroll, supplies, freight and other services. The funds on hand are only sufficient for about one month's average operation	\$ 22,763,267	\$ 836
MARKETABLE SECURITIES -- Including substantial amounts of United States and Canadian government bonds some of which are on deposit with various governmental authorities to guarantee compliance with their milk control laws, workmen's compensation acts, etc.	9,586,708	352
RECEIVABLES -- Money to be received by us from customers and others. This represents about 20 days' sales, most of which was collected currently in January	16,459,548	605
INVENTORIES -- Stocks of finished goods, goods in process, raw materials and supplies in plants and warehouses	28,847,337	1,060

⁸⁴Annual Report to Stockholders, Borden's, 1942.

MISCELLANEOUS ASSETS -- Consisting principally of mortgages received from sales of properties and loans to farmers to purchase cattle, collection of which will extend beyond the current year and therefore are not included in current receivables above			3,165,185	116
PROPERTY, PLANT AND EQUIPMENT -- Plants in which our employees work; also machinery, processing and delivery equipment, fixtures, etc., used in our operations; after deducting the allowance for accumulated wear and tear to date (which is the depreciation reserve)			68,964,011	2,534
PREPAID ITEMS AND DEFERRED CHARGES -- Including prepaid taxes, rents, etc.			1,018,063	38
TRADE-MARKS, PATENTS AND GOOD-WILL-- For which the Company expended millions in advertising and research. For conservative purposes this is carried at a nominal amount			<u>1</u>	
TOTAL OF WHAT WE OWNED (Assets)			<u>\$150,804,120</u>	<u>\$5,541</u>

WE OWED (Liabilities)

CURRENT LIABILITIES -- Including bills for milk, materials, supplies and services purchased, principally in December, but not due for payment until January. This also includes provision for commissions and payrolls for the last part of the month and items on which bills have not been rendered, such as taxes exclusive of U.S. Income Taxes which have been provided for by our holdings of U. S. Tax Savings Notes, and other miscellaneous expenses, as well as maturities of serial notes due in 1943 in the amount of \$501,000

\$19,282,081

NON CURRENT LIABILITIES -- Represents liabilities not payable within the next 12 months. Notes payable after 1943 in the amount of \$10,998,000 is the principal item herein

11,376,014**TOTAL OF WHAT WE OWED (Liab.)**\$ 30,658,095

STOCKHOLDERS' FUNDS AND RESERVES**Represented by:**

Amounts which have been retained
in Reserves for contingencies
that may arise and for other
operating purposes \$17,292,640

Stockholders' investment in the
Capital Stock and Capital Sur-
plus of the Company 79,315,806

Stockholders' investment in
Earned Surplus—being that part
of past earnings retained in the
business to strengthen the
Company's financial condition 23,537,579

TOTAL STOCKHOLDERS' FUNDS AND RESERVES \$120,146,025

Illustration X**THE RESULTS OF 1942 OPERATIONS**⁸⁵

The Statement of Net Income, sometimes referred to as the Profit and Loss Statement, shows the results for the full year's operations. In the following tabulation this is shown in relation to each dollar of sales. The figures cover all products and all markets and the resultant profit, therefore, is much better than the unsatisfactory return from fluid milk operations alone.

At the end of 1942 the inventories of finished goods were \$2,075,400 less than at the end of the previous year due to the abnormal demands made upon some divisions, for the greatly augmented requirements of our own armed forces and the government's lend-lease program. Therefore more goods were sold in 1942 than were produced during that year. Hence, the following statement reflects not only the money paid to farmers and employees during the year, but also includes such expenditures for products made in the previous year but sold during 1942.

RECEIPTS:

		Cents per Dollar of Sales
SALES — Amount charged our customers for products sold	\$325,350,306	100. ¢
OTHER INCOME — Including rentals, royalties and interest expense and provision to Reserve for Miscellaneous Assets	<u>187,914</u>	
TOTAL	<u>\$325,538,220</u>	

⁸⁵Ibid.

DISPOSITION:

TO FARMERS -- Paid for milk, cream, butter, cheese, etc., a total of \$151,943,042 during 1942 and approximately \$1,320,000 in the previous year for products then produced but sold during 1942 \$153,263,042 47.1¢

PAYROLL -- Wages and salaries paid to employees during 1942 amounted to \$57,886,360 and in addition approximately \$82,000 was paid in the previous year to produce goods not sold until 1942 57,968,360 17.8¢

TAXES -- To Federal, State, local and Canadian governments (This amount for taxes is nearly twice as much as the remaining Net Income for the year) 15,096,404 4.6¢

**TOTAL DAIRY PRODUCTS,
PAYROLL AND TAXES** \$226,327,806 * 69.5¢

*This 69.5¢ is for all combined operations including evaporated milk, dry milk, ice cream, etc., as well as fluid milk. In divisions conducting a fluid milk business only, the ratio of these costs to the sales dollar is higher, being about 85.4¢.

COSTS AND EXPENSES OF OPERATIONS-- Paid suppliers for bottles, containers, packing materials, coal, oil, gasoline, feed, sugar, tin plate and other materials; and others for services such as freight rent, light, power, telephone, telegraph, advertising, repairs, and other items, and including special reserve provisions made because of wartime contingencies, and after absorbing all other cost factors of inventory fluctuations 84,347,446 25.9¢

DEPRECIATION -- This year's proportion of the amount necessary to provide for the eventual replacement of buildings, machinery, vehicles and equipment, due to wear and tear in the Company's operations

	<u>\$ 6,483,314</u>	<u>2.4</u>
TOTAL OF ABOVE COSTS AND EXPENSES	<u>\$317,158,566</u>	<u>97.44</u>

NET INCOME -- (Net earnings before dividends)

	<u>\$ 8,379,654</u>	<u>2.64</u>
--	---------------------	-------------

This represents a return on sales of 2.64. After payment of dividends of \$6,134,209 to 49,034 Stockholders, the balance of Net Income was left in the business to strengthen the Company's financial condition.

The U. S. Steel, Illustration XI, General Mills, Illustration XII, S. S. Kresge, Illustration XIII, and the American Colortype Company, Illustration XIV, all present explanatory profit and loss statements for the past few years operations. While different in preparation, they all three explain where the income came from and its disposition in very simple and non-technical language. Illustration XI is the Profit and Loss Statement for U. S. Steel as presented in the 1942 Annual Report.

Illustration XI
SALES AND COSTS IN 1942 AND 1941⁸⁶

	Year 1942	Year 1941
Products and Services Sold	<u>\$1,865,951,692</u>	<u>\$1,622,355,922</u>
This sum was disposed of as follows:		
Wages, Salaries, Social Security, Taxes and Pensions	782,661,701	628,275,135
Taxes--Federal, State and Local	203,755,157	168,645,848
Products and Services bought from others	648,401,343	579,640,279
Wear and Usage of Facilities	128,161,530	98,590,187
Estimated additional Costs caused by war	25,000,000	25,000,000
Interest on Indebtedness	6,153,392	6,033,398
Dividends on cumulative preferred stock	25,219,677	25,219,677
Dividends on common stock	34,813,008	34,813,008
Carried forward for future needs	<u>11,785,884</u>	<u>56,138,390</u>
Total	<u>\$1,865,951,692</u>	<u>\$1,622,355,922</u>

Illustration XII

THE YEAR IN BRIEF⁸⁷

From the sale of our goods and services, we received	\$217,485,502
To run our business, pay our employees, buy materials to make our goods, and provide reserves, it cost us	<u>\$202,601,772</u>
This left us before income taxes	\$ 14,883,730
To pay our income taxes, we set aside	<u>\$ 9,517,785</u>
This left us a net income of	\$ 5,365,945
Out of this, Preferred Stockholders received	\$ 1,107,365
Our Common Stockholders were paid the same as last year, \$4 per share	<u>\$ 2,660,216</u>
This left us with earnings in excess of dividends paid	\$ 1,598,364*

*Because of an additional contribution of \$560,000 to the Retirement System, the net addition to surplus for the year was \$1,038,364.

Illustration XIII
SALES INCOME AND ITS DISTRIBUTION⁸⁸
YEARS 1941 AND 1942

PARTICULARS	AMOUNT		% TO SALES	
	1941	1942	1941	1942
Sales				
Amounts taken in for merchandise sold.	\$176,184,464	\$198,679,843	100.00	100.00
Cost of merchandise sold and expenses, exclusive of taxes, salaries and wages and interest paid	<u>124,728,926</u>	<u>138,978,930</u>	<u>70.79</u>	<u>69.95</u>
Balance				
The amount remaining to pay taxes, wages and interest and including the net income of \$7,982,281 in 1942 and \$9,448,123 in 1941.				
DISTRIBUTION				
1. Taxes Real estate, personal property, State and Federal franchise and income taxes, sales taxes, licenses, etc.	\$ 12,667,407	\$ 18,410,437	7.19	9.27
2. Salaries and Wages The employees' share.	28,248,645	31,913,643	16.03	16.06
3. Interest paid for use of borrowed money	60,976	53,552	.03	.03
4. Cash Dividends Paid to stockholders for use of their money— \$1.35 on each share in 1941 and \$1.15 on each share in 1942.	7,411,327	6,313,355	4.21	3.18
5. Earnings retained in the business, including the reserve provided for possible postwar adjustments in merchandise values	<u>3,067,183</u>	<u>3,009,926</u>	<u>1.75</u>	<u>1.51</u>
	<u>\$ 51,455,538</u>	<u>\$ 59,700,913</u>	<u>29.21</u>	<u>30.05</u>

⁸⁸S. S. Kresge Company, 31st Annual Report to Stockholders, 1942.

Illustration XIV

TO THE STOCKHOLDERS OF AMERICAN COLORTYPE COMPANY.⁸⁹

In 1941 the Company again increased shipments and net earnings after paying largely increased taxes. Following is the comparative detail of our income and outgo during the years 1941 and 1940. For convenience, figures are given in even dollars.

Income and Expenses During 1941 Compared with 1940 Income

	<u>1941</u>	<u>1940</u>
1. We billed out customers for products purchased from us	\$8,839,262	\$8,098,021
2. From which we deducted discounts and provision for bad debts and allowances	<u>110,965</u>	<u>114,054</u>
3. Leaving us a net return from billings of	\$8,728,297	\$7,983,967
4. We received interest, rents and royalties amounting to	<u>37,263</u>	<u>25,410</u>
5. Which gave us a total income to work with of	\$8,765,560	\$8,009,377

Disposition of Income

6. We paid out and set aside for wages, materials, power, insurance, repairs, taxes, supplies and manufacturing expenses in general	\$6,430,202	\$5,825,519
7. Commissions and other selling costs amounted to	1,065,520	1,016,200
8. Office salaries and other administrative costs were	503,884	488,615
9. We paid out for taxes and expenses on property leased to others	19,343	15,106
10. Our machinery and building depreciation amounted to	<u>159,421</u>	<u>152,843</u>

⁸⁹Annual Report, American Colortype Company, 1941.

11. Leaving us with	\$ 587,190	\$ 511,094
12. We paid interest on borrowed capital of	40,070	49,466
13. We have set aside for federal government income taxes	187,906	114,803
14. Leaving earnings of	\$ 359,214	\$ 346,825
15. Cash dividends paid to our Preferred Stockholders (and to the holders of the Preferred Stock of the American Art Works, Inc., in 1940) amounted to	<u>37,215</u>	<u>47,308</u>
16. Leaving for long term debt retirement, for additional working capital, and for the holders of Common Stock	\$ 321,999	\$ 299,517

Because of the interest in personnel relations and because the majority of employees of a large company do not understand the technical terms involved in a general accounting statement, explanatory statement presentation has been employed more in employee reports than in stockholder reports. Many annual reports, however, have been prepared not only for the stockholders but also for the employees and the general public. The Goodyear Tire & Rubber Company's annual report to stockholders for 1940 contained not only a report to stockholders but also to the employees. The following statement, Illustration XV, is taken from the 1940 report:

Illustration XV

Here is the record of our operations for the year 1940:⁹⁰

WE RECEIVED

1. From customers who bought our tires, tubes and the other goods we make and sell (including excise taxes and transportation charges which are deducted from sales in the formal statement). \$234,174,371
 2. From other sources such as for interest and rents 1,087,607
- Which gave us a total income for the year of 1940 of \$235,261,978

WE PAID OUT

1. To the year's average of 39,352 employees (exclusive of 10,385 employees on rubber plantations) in wages and salaries \$ 60,655,160
2. For rubber including plantation payrolls, cotton, chemicals, fuel, supplies, other raw materials and for other items including transportation and advertising expense \$124,672,568
3. As a reserve for contingencies and against the wearing out of plants and machinery 11,089,303
4. As taxes to cities, states and the federal government \$ 15,430,596
5. As taxes and duties outside the United States \$ 10,860,069
6. In interest on borrowed money used in the business and as dividends on stock not owned by Goodyear in our foreign subsidiaries \$ 2,244,494

This left profits from the year's operations amounting to \$10,309,788.

Out of these profits we paid dividends of \$5.00 on each of the 642,632 shares of outstanding preferred stock and \$1.25 on each of the 2,059,168 shares of outstanding common stock.

Our total income of \$235,261,978 in 1940 compared with \$216,496,842 for 1939.

Financial and operating reports to the employees themselves are now a common occurrence. While many of the reports are incorporated in the house organs, others are presented as separate reports. The Mengel Company, makers of wooden and plywood products, presents the following explanatory statements, Illustration XVI and XVII, to their employees in 1942:

⁹⁰Annual Report, The Goodyear Tire and Rubber Co., 1940.

Illustration XVI

THE MENGEL COMPANY⁹¹

Explanatory Balance Sheet--December 31, 1942

WE OWNED

Cash for payrolls, materials, taxes, and for other expenses--deposited in 7 major banks and 14 community banks	\$ 819,300
Money due from customers	3,142,200
Value of materials, products in the course of manufacture, and finished products ready for sale	3,896,100
Notes and accounts due the Company, but which have time to run before they are paid; and other miscellaneous securities the Company has obtained in the conduct of its business	401,400
The factories, warehouses, other buildings, tools, equipment and furniture cost \$8,651,400, but as they become used and are no longer new this loss in value must be recognized. Therefore, the factories, warehouses, tools, equipment, etc., are now valued at	4,072,300
In addition to the above properties, the Company has certain land, buildings, and equipment no longer required in its operations. This property is carried at a value of	252,100
Value of timberlands and standing timber. (In addition the Company has rights to timber which do not appear in this statement).	567,800
Investment in logging operation in Africa	51,900
Money paid in advance for insurance, taxes, logging and saw mill expenses, and for the cost of issuing our bonds	<u>241,500</u>
The sum of these represents the total assets, or what the Company requires to do business	<u>\$13,444,600</u>

⁹¹Review of 1942 Operation for Employees, the Mengel Company, Incorporated.

WE OWNED

Bonds or fixed mortgages on the property of the Company. We are making every effort to reduce this amount. (Reduced \$236,000 during 1942)	\$ 1,693,000
Notes payable, banks (borrowed to carry on the business)	750,000
Bills for materials, supplies, and services, received but not yet due for payment	493,800
Payrolls, interest and other items not yet due, but which are accumulating, and for which the Company must be preparing to make payments when due	309,800
Federal and State taxes on income and property taxes, payable during the year 1943.	1,897,100
Reserves for losses that may be sustained in disposing of certain properties and other reserves	857,900
Money the stockholders have entrusted to the Company with which to do business and for which they hold stock certificates	7,443,000

In 1942 this money was increased
\$501,000 as follows:

Net profit for the year	\$770,400
Less miscellaneous adjustments	<u>1,600</u>
	768,800
Less, dividends paid to holders of stock in the Company	<u>267,800</u>
	<u>\$501,000</u>

Surplus is needed for carrying on during periods of loss and for arranging to meet new demands for Mangel products; therefore, it is a very necessary safeguard back of the job and it is important that we continue to increase this amount.

Making a total of

\$13,441,000

Illustration XVII
THE MENGEL COMPANY⁹²
EXPLANATORY STATEMENT OF OPERATIONS
YEAR 1942

MONEY RECEIVED	<u>Amount</u>	<u>Percent</u>
During the year, we billed our customers for Mengel products they purchased (our principal products are listed elsewhere herein)	\$24,216,400	
Cost of transporting products to customers	\$504,400	
Cash discounts allowed to customers for prompt payment of bills were	259,000	
Value of materials returned and allowances made to customers were (This means that we fell down in quality of our product, and the amount is much greater than last year)	109,700	<u>873,100</u>
Leaving net sales of	\$23,343,300	
Income from rents and other miscellaneous sources was	<u>90,700</u>	
Which Gave Us A Total Income Of	\$23,434,000	100%

HOW THIS MONEY WAS USED

We paid for materials, supplies, fuel, transportation and other expenses	\$11,758,000	50%
These payments went to suppliers for goods and services in many states and foreign countries. Much of this money became wages in other industries. The industries from which we buy the largest amounts are lumber, paper, finishing materials, glue, etc., but the total number of suppliers from which we buy is many hundreds.		

⁹² Ibid.

EXPLANATORY STATEMENT OF OPERATIONS --- ContinuedYEAR 1942

We set aside to replace plants and tools and other equipment as they wear out and the using up of outstanding timber	647,100	3%
<p>The Mengel Company has some of the finest manufacturing machinery in the world. But even the best wears out sometime or other and has to be replaced. Moreover, though we still had lots of standing timber, we used up many logs in 1942. To take care of the aging of plants and equipment and the using up of our standing timber, it was necessary to provide this amount for the year.</p>		
And the tax bill were	\$ 2,140,500	9%
<p>This has gone to the Federal government, to various state governments, and to local communities, cities, counties and schools. Social Security taxes made up \$258,700 of the above amount. This is independent of the tax (\$92,300) which was paid by the employees themselves by payroll deduction. The Company paid 2 3/4 times as much as employees. Some of the Social Security taxes paid by the Company are intended to come back to employees in years to come in the form of Federal Old Age Benefits.</p>		
These disbursements for materials, supplies, fuel, transportation, replacements, interest and taxes amount to a total of	<u>14,545,600</u>	<u>62%</u>
Which Left For Employees, Stockholders, and Future Requirements	\$ 8,888,400	38%
Of this amount, wages and salaries were paid to employees in the amount of	\$ 8,118,000	35%
<p>This represents 91 cents out of every dollar left after we paid our bills. Of the total of \$8,118,000 paid to employees, the officers who are directors and other directors received approximately 2%.</p>		
Dividends paid to stockholders	267,800	1%
Left for future needs (added to surplus)	<u>502,600</u>	<u>2%</u>

The Blaw-Knox Company made the following statements, Illustration XVIII and Illustration XIX, to their employees for their 1938 operations:

Illustration XVIII
AN EXPLANATORY BALANCE SHEET⁹³
Blaw-Knox Company and Subsidiary Companies
As of Dec. 31, 1938

Average of Assets Per Each of the 9,077 Stockholders		ASSETS -- (WHAT THE COMPANY OWNS)	
\$ 50.79	Cash on hand and in banks	\$ 460,101.70	
1.67	Securities at market value as of 12/31/38	15,283.75	
150.98	Customers owe us for goods sold	1,370,573.62	
234.18	Stocks of finished goods and raw materials	2,125,746.94	
1.28	Other current assets	11,607.51	
438.90	TOTAL CURRENT ASSETS	3,983,313.52	
1.76	Customers owe us on long terms, not current	15,950.00	
142.86	Invested in partly-owned American subsidiary companies	1,296,547.20	
62.14	Invested in our foreign subsidiary companies	564,118.51	
1.71	Invested in other companies	15,551.46	
54.53	Patents, trade-marks, and goodwill	495,051.79	
1,463.50	Our lands, buildings and machinery	13,284,712.20	
8.93	Deferred charges	80,821.28	
\$2,174.30	TOTAL ASSETS	\$19,736,065.96	

⁹³ A Report to the Employees of the Blaw-Knox Company, 1938.

AN EXPLANATORY BALANCE SHEET -- Continued

**Average of
Assets In-
vested for each
of the 2,727
Employees**

LIABILITIES --(WHAT THE COMPANY OWES)

\$ 168.72	To pay for raw materials, wages, etc.	\$ 501,196.39
5.60	Notes to pay for money borrowed from bank	800,000.00
502.59	We owe for general accrued expenses	75,428.55
779.52	We owe for accrued Social Security taxes, Federal and Pennsylvania State Capital Stock and Income taxes	286,674.05
1,460.69	TOTAL CURRENT LIABILITIES	1,663,298.99
5.84	Reserve for "contingencies" which may arise	261,717.40
475.45	Miscellaneous reserves	69,073.85
206.86	Earned Surplus, or savings from past earnings reinvested in the business	2,616,275.82
5.70		
181.54	Capital Stock	11,120,495.21
4,871.56	Capital Surplus	4,005,204.69
29.64		
\$7,237.28	TOTAL LIABILITIES AND CAPITAL	\$19,736,065.96

Illustration XIX

HOW WAS THE BLAN-KNOX 1938 RECEIPT DOLLAR DISTRIBUTED?⁹⁴

Gross sales of the Company amounted to \$10,753,106, an average of \$3,943 per employee. How this money was used is shown by the chart on page , and explained in tabular form below. It will be observed that the payrolls took 39 per cent of the income, while source goods and services (raw materials) cost us 45 per cent, and we set aside less than 3 cents for replacement of wearing out plants and equipment (depreciation).

INCOME:	Total Amount	Per Employee
1. We charged out customers for products	\$10,753,106	\$3,943.20
2. From which we allowed for bad debts	4,911	1.80
3. Leaving a net sales return of	10,748,194	3,941.40
4. Plus other income in the form of rent, interest, dividends, etc.	289,321	106.09
5. Giving us a total income of this amount for the operation of our business	11,037,515	4,047.49
EXPENDITURES:		
1. We paid others for raw materials, services, fuel, transportation, etc.	\$4,957,274	\$1,817.85
2. Required by government in taxes	360,831	132.32
3. Set aside for wear and tear on equipment	303,452	111.28
4. Plus other expenses, including advertising, research, etc.	996,531	365.42
5. Left us with this amount for employees, stockholders, and reinvestment	4,419,427	1,620.62
6. Employee payrolls took this amount	4,273,826	1,567.23
7. Leaving this profit, all of which was retained in the business	145,601	53.39

⁹⁴Ibid.

As the statements are incorporated as a part of the reports, many times the explanatory heading of the statement is a part of the text material. This is true in almost every case in the preceding illustrations.

Tabular Presentation

While the general accountant very seldom has his work published, the public accountant is very likely to have the results of his work presented in printed form. Any statistical tables which are presented in his report should take cognizance of the possibility of the work being further reproduced.

In addition to the discussion of tabular presentation as given in Chapter VIII, the public accountant needs to know how to divide a table with the common printing rulings. Vertical as well as horizontal rulings may be incorporated as a part of the table for better appearance and easier reading. Usually, double light rules block off the captions which describe the columns. The bottom of the table also has double rulings. Single rulings are employed as vertical rulings unless separate sections are desired in the columns. The table may or may not be blocked off with rulings at the side, but the usual procedure is to leave off as many rulings as is possible.

In addition to the previously described tables, the accountant may present in the annual reports such items as sales trends, production trends, ownership analysis, and many other significant items. The General Mills Company as a part of their 1943 report presented the following analysis, Illustration XX, of the ownership of the company for public information.

Illustration XX

ANALYSIS OF COMPANY OWNERSHIP⁹⁵

Common and Preferred Stock Holdings

By Number of Shares

<u>No. of Shares</u>	<u>Common Shareholders</u>	<u>Preferred Shareholders</u>
1- 99	5,419	2,369
100- 199	900	213
200- 299	208	73
300- 399	97	24
400- 499	51	13
500- 999	135	47
1,000- 4,999	101	34
5,000 and over	7	4

By States

<u>State</u>	<u>Common Shareholders</u>	<u>Common Shares</u>	<u>Preferred Shareholders</u>	<u>Preferred Shares</u>
Alabama	4	80	2	210
Arizona	29	896	10	180
Arkansas	13	406	2	310
California	397	27,226	231	13,273
Colorado	40	2,186	22	335
Connecticut	204	19,164	47	5,432
Delaware	24	5,244	4	124
Dist. of Columbia	102	5,706	40	1,622
Florida	56	2,128	19	454
Georgia	23	1,234	3	60
Idaho	7	146	3	30
Illinois	385	33,101	217	8,548
Indiana	47	2,524	10	119
Iowa	56	1,473	19	559
Kansas	34	3,208	42	1,729
Kentucky	29	1,339	3	110
Louisiana	15	384
Maine	25	589	7	92

⁹⁵Annual Report, General Mills, 1943.

ANALYSIS OF COMPANY OWNERSHIP --- Continued

<u>State</u>	<u>Common</u>		<u>Preferred</u>	
	<u>Shareholders</u>	<u>Shares</u>	<u>Shareholders</u>	<u>Shares</u>
Maryland	107	4,743	23	1,088
Massachusetts	847	50,051	71	5,691
Michigan	167	14,588	41	2,018
Minnesota	706	160,933	918	99,157
Mississippi	8	169
Missouri	189	13,826	64	3,679
Montana	45	3,392	29	1,594
Nebraska	16	309	8	266
Nevada	4	59	1	11
New Hampshire	26	426	7	814
New Jersey	274	11,208	79	3,095
New Mexico	1	100	2	55
New York	1,689	204,947	461	39,327
North Carolina	15	310	14	190
North Dakota	7	201	18	202
Ohio	296	15,591	53	2,264
Oklahoma	33	3,144	11	435
Oregon	25	674	11	278
Pennsylvania	268	34,732	100	20,183
Rhode Island	89	4,443	25	1,658
South Carolina	16	132	1	10
South Dakota	12	406	6	160
Tennessee	24	987	3	55
Texas	81	7,935	13	460
Utah	11	149	5	52
Vermont	29	862	3	40
Virginia	57	3,026	15	359
Washington	75	2,993	23	449
West Virginia	24	1,244	10	551
Wisconsin	77	2,966	63	1,566
Wyoming	11	6,722	7	1,718
Foreign	99	6,752	11	1,133

Charts

For easier grasping of numerical facts presented in the reports for employees and stockholders, charts are very common. The pie diagram, the bar chart, and the line diagram are all commonly used. For example, the American Colortype Company in the 1941 annual report employed bar charts throughout the report. Two colors, red and black, were used to make a finer distinction in the comparisons. The New Rochelle, New York Auditor's Annual Report for 1941, contains charts in the form of silver dollars, one representing income and one representing expenses. A section of the dollar is separated from the main circle in each diagram which represents items which were under the control of the city administration.

In almost every report for a company which has a national organization, pictorial maps showing major locations of supply, demand, or outlets for the various products are employed. Large companies such as General Motors often use pictorial maps to show where the various parts of the completed products originate.

CHAPTER XI

STATISTICAL METHODS FOR COST ACCOUNTANTS

Cost Accounting and General Accounting

Since the beginning of the twentieth century, cost accounting has become one of the major developments which business has adopted to provide information for managerial control and policy making. While cost accounting is not a different method from general accounting, it does extend procedures to much greater lengths than what is found in general accounting. Dohr, Ingraham, and Love say the following regarding cost accounting:

The cost accounts have primarily to do with the financial figures relative to the manufacturing operations. The ledger accounts will record for the most part only the dollar amounts of the various elements of cost, including the materials and supplies, the labor and the factory service. In order, however, to have these figures serve their purpose best, it will be necessary to correlate them with the statistics of production and distribution so that every cost system will involve the use of a certain amount of operating and distribution statistics. These will include a record of the materials used, the amount of waste material, the number of labor hours, the number of machine hours, the amounts of products finished, etc. In addition to this, the management will require other statistics, such as material turnover, labor turnover, number of men employed, number of hours the factory operates, number of idle machines, etc.

These statistics should be carefully studied and arrangements made to keep all that are necessary for the cost or administrative purposes.⁹⁶

Very little of the actual work of recording in cost accounting falls within the scope of statistical methods. In cost accounting analysis, however, statistical methods are employed in all of the procedures involved. While the basic procedures in cost accounting are the same as in general accounting, the cost of goods sold in cost accounting is determined for units as well as for the total goods sold. The record of the units may be kept in the double-entry accounting system or it may be kept in a separate statistical record. Neumer makes the following statement:

. . . Many accountants feel, therefore, that detailed cost data should be statistical data to assist and guide management and might very well be independent of the general accounting records. On statistical records it would be possible to include interest on investment and depreciation charges, which may not be included under the financial and income tax accounting. The use of standard, estimated, or predetermined costs is also possible without affecting the financial records. It must be recognized, therefore, that there are two methods of compiling costs, namely, statistical and accounting.⁹⁷

Whether the cost data are kept as a part of the double-entry system or as separate statistical information, the data upon which the cost accountant reports to management are similar. The reports to management, aside from the regular financial reports, are statistical in nature, and it is the purpose of this section of the paper

⁹⁶James L. Dohr, Howell A. Ingraham, and Andrew L. Love, Cost Accounting Principles and Practices, Second Revised Edition, The Ronald Press Company, New York, 1935, p. 69.

⁹⁷John J. W. Neumer, Cost Accounting Principles and Practices, Business Publications, Inc., Chicago, 1938, p. 52.

to investigate the various procedures involved in cost accounting which use statistical methods as their bases.

Types of Cost Systems

Although there are numerous uses of cost accounting systems, three special types have been developed and classified as separate cost systems. They are:

1. Job Order or Production Order Cost Accounting.
2. Process Cost Accounting.
3. Standard Cost Accounting.

Job Order or Production Order Cost Accounting is a type of record keeping of the values of material, labor, and overhead expenses which, when analyzed, will show the cost necessary to complete any one specific order of finished goods. The costs are entirely historical costs for material and labor, but those expenses which are overhead costs are usually distributed on some arbitrary basis to determine the finished cost of the specific job.

Process Cost Accounting is a type of record keeping of values pertaining to the production of commodities or services, which when analyzed, show the cost of a given process, run, or quality of production. Process cost accounting is used primarily in plants which produce under mass production principles. To determine the cost of any process, or division of operations necessary in making the goods, raw materials and labor are charged directly to the department or process accounts each fiscal period. Overhead expenses are distributed either directly or on some arbitrary basis to the accounts at the

end of the period to determine the total cost of production for that period. By determining the number of units which have been processed in the department, the average cost of production per unit can be determined. The major statistical procedures in process cost accounting are involved in determining the amounts of material, labor, and overhead in the work in process left from the preceding period and at the end of the present period and loss or gain in units during the production period, and the equivalent units of production the goods in process inventories would equal if fully completed.

Standard cost accounting is the newest of the systems of cost accounting. Although many accountants do not give it the distinction of being a system by itself, others do. Standard cost accounting may be based on either job-order costs or process costs. Standard or theoretical average costs are developed for material, labor, and overhead for either specific jobs or processes, and when actual costs have been accumulated during a period they are compared with the standard costs for deviations in rate and quantity.

Estimating costs and distribution costs have at times been given the rating of cost systems. Estimating costs are predetermined costs of production for some particular job or order. Comparisons are made between the predetermined costs and the actual costs when the job is completed. Estimating costs are similar to standard costs in comparing a predetermined cost figure with actual costs, but do so for only a certain job or for a certain quantity of factory output.

The primary interest of cost accountants has been in the field of manufacturing since the beginning of cost accounting. Within the

last generation, attempts have been made to measure the cost of distributing products as well as the cost of manufacturing the products. Distribution cost analysis determines the amount of selling and administrative expense allocable to each unit of product sold, to each sales office, to each salesman, and to each order.

Job Order Cost Accounting

Job order cost accounting is probably the best known type of accounting system. The system may be used in any type of manufacturing enterprise which produces special work, manufacturing to order, or manufacturing by special job. The purpose of the system is to collect all costs of material, labor, and overhead which pertain to one particular job. The statistical techniques involved in job-order cost accounting pertain mainly to the evaluation of inventories, to the evaluation of labor, and to the distribution of overhead.

Inventory Accounting

Raw Material Control

The inventories carried by a manufacturing company are of three different types: raw materials, goods in process, and finished goods. Raw material costs average 55% of the total of manufacturing costs of all industries.⁹⁸ With such a large percentage of costs coming from

⁹⁸Ibid., p. 124.

the raw materials, it is important that proper methods of control be established for the materials.

When a company has an excessively large proportion of its costs being made up of the raw materials, it is very important that the correct amount of materials be on hand at all times. Estimating the requirements of raw materials is as basic in the control of inventories as any one other essential. The Cost and Production Handbook has the following to say regarding raw materials estimating:

Raw materials estimating should be result of a careful and complete survey of product to be manufactured. Purpose of method of estimating is to insure supply of a sufficient amount of material for order or lot, and no more. All of factors which may produce a shortage in some extreme case should be taken into consideration in order that estimate may be safe and not excessive. An excessive estimate will result in an overstock of raw materials left on hand after running required number of parts and thus increase proportionately cost of each piece. Ideal raw materials estimate, then, is one which is so accurately balanced that it will insure a sufficient amount of stock for required number of parts with a minimum of excess material at end of run. Where such estimating prevails, cost of product is never out of proportion to materials charges. In making such estimates good judgment is necessary in determining allowance for various factors, such as variations in weight due to variations in thickness and composition, and others concerned with product, manufacturing equipment, and methods of materials handling.⁹⁹

Advance sales and production forecasting is a natural result of inventory estimating, as no company can operate without materials, yet no company can have those materials without advance provision.

⁹⁹L. P. Alford, Editor, Cost and Production Handbook, The Ronald Press, New York, 1934, p. 412.

Time is necessary to order materials and secure delivery. If too much has been ordered, excess expenses accumulate from interest and handling charges. If too little has been ordered, costly shutdowns and delays may result.

Statistical methods may be employed profitably in forecasting trends of sales and production requirements. In conjunction with information from private statistical sources, and from the government, it is possible to forecast fairly accurately the sales of the company under its special conditions.

In a lecture before the National Association of Cost Accountants, Mr. Cartwell said:

As a generalization and a broad conclusion, we can say that buying based upon attempts to outguess the rest of the world on future prices cannot be justified, but management may be justified in protecting its future for as long a period as current selling prices are expected to hold and not be increased because of upward trends in costs.¹⁰⁰

The forecasting of sales is probably more important for cost accounting than it is for general accounting. The general principles, outlined in Chapter VI, for forecasting sales through the use of trends, cyclical fluctuations, and seasonal variations, and through comparison with other agencies which forecast professionally, also hold true for cost accounting. A forecast of sales is necessary before forecasting production, as production is dependent upon sales. Of course, the lag between production and sales also has to be considered.

¹⁰⁰Ibid., p. 106.

When the probable sales are determined by the use of trends and forecasts, it is possible to outline future production requirements. Production schedules might also be determined by taking past records and finding the variations in seasonal production. The seasonal pattern is as important in production as in sales and it is possible to find the lag from production to sales, making it possible to determine the production requirements both from sales and seasonal production.

Cost accounting demands that a perpetual inventory accounting method be used. To determine the cost of the articles manufactured, a knowledge of the amounts and costs of the materials which go into the goods is necessary. While a physical inventory is taken at the end of each period or at some convenient time during the period, a continuous record which shows the amount purchased, delivered (requisitioned), returned, or destroyed and the values of the various units is necessary for accurate determination of the costs to be charged for the direct or indirect materials used in the manufacturing process. Usually, each type and grade of material is separately recorded so that it will not be necessary to use averages of different qualities or kinds of materials consumed.

The value of each individual unit of raw materials must be known to determine the final finished goods cost in job order and process cost accounting, while in standard cost accounting the value must be known to determine the variation from standard. Under a book inventory method, a knowledge of the number and purchase price of each individual type and grade of goods is available. The items

which go to make up the original cost include: (1) the purchase price of the raw materials, (2) the costs of shipping the materials to the company, and (3) any shrinkage or wastage of the articles before they are charged out of the storeroom. Since any of the above three items can vary from shipment to shipment, to obtain a value for each unit for charging the correct amount to the various jobs, several methods have been devised. Although the list is not inclusive, the better known methods are:

1. First in, first out
2. Average method, either a moving average or period average
3. Last in, first out
4. Standard value
5. Cost or market, whichever is lower

First in, first out. In determining the unit values to be charged by the first in, first out method, the actual purchase price of the goods is charged to the job. The purchase price of the first goods received is the value charged out for the inventory until they have been completely exhausted. The oldest material on hand is charged out first. To illustrate the first in, first out method, assume that the inventory has 100 units at a cost of \$1.00 each on hand on June 1, 1943. On June 2, 50 more units were added at a cost price of \$1.10 and on June 3, 50 units were withdrawn from stock. The 50 units added on June 2 would have to be considered separately from those on hand, as those on hand would have to be costed out first. The materials withdrawn on June 3 would be charged out at a value of

\$1.00 each, which would leave an additional 50 units left in the inventory valued at \$1.00 and 50 units at \$1.10. If on June 15 an additional 50 units were purchased at a cost of \$1.20, the inventory valuation would be as follows:

50 units at \$1.00	\$ 50.00
50 units at 1.10	55.00
50 units at 1.20	<u>60.00</u>
Total value	<u>\$165.00</u>

If on June 20, 75 units were withdrawn, 50 would be costed out at \$1.00 while the next 25 would be costed from the inventory at \$1.10. The value of the inventory would then be:

25 units at \$1.10	\$ 27.50
50 units at 1.20	<u>60.00</u>
	<u>\$ 87.50</u>

Such items as freight-in and sometimes certain handling charges must be charged to the cost of the goods before determining the unit costs. These expenses are usually charged on a blanket basis to the total shipment and then the costs are allocated on an average basis per unit. In the case of the allowance or return of some materials at a price which is not on the books, an average price will be necessary. Of course, if the price at which the goods are returned is available, they will be taken out of the inventory at that price. If excess materials are returned to the storeroom, they are returned at the price at which they had been charged out of the storeroom.

The Average Method. The average of prices which is used to determine the value at which to charge out goods from the stockroom

may be computed by two methods: (1) the moving average, and (2) the preceding period average. The moving average method is employed more often than the preceding period average method. The moving average method is very suitable where the prices of materials fluctuate frequently, while the preceding period average method is just the opposite and is more suitable when prices are fairly constant.

The moving average method is computed as the weighted mean of all of the materials whenever any new materials are added to the inventory. To illustrate the moving average method, if the purchases and withdrawals are similar to those employed in the illustration of the first in, first out method, the 100 units on hand on June 1, 1943, would continue to be valued at \$1.00 each. However, when the 50 additional units are added on June 2, the value of the units would be neither \$1.00 nor \$1.10 but would be computed by weighting the \$1.00 price by 100 units and the \$1.10 price by 50 units, as follows:

100 units at \$1.00	\$100.00
<u>50 units at 1.10</u>	<u>55.00</u>
150 units	<u>\$155.00</u>

$$\$155.00 \div 150 \text{ units} = \$1.03333 \text{ per unit.}$$

When the 50 units are withdrawn on June 3, they will be costed out at \$1.03333 per unit, making a total left in the inventory of 100 units at \$1.03333 each, or \$103.33. When the 50 additional units are added on June 15, at a unit cost of \$1.20, a new unit average would have to be determined for the inventory:

100 units at \$1.03333	\$103.33
<u>50 units at 1.20</u>	<u>60.00</u>
150 units	<u>\$163.33</u>

$$\$163.33 \div 150 \text{ units} = \$1.088889$$

Since the 75 units are withdrawn on June 20, they would be costed at \$1.088889 each, or \$81.67, leaving a balance of 75 units at the same unit cost and the same total cost.

Sometimes it is easy for a concern to determine the average cost at the close of each month and apply the average for all requisitions for the following month. Obviously, in the above illustration, this method would not be successful, since the variations in price at different points during the month fluctuate too much. Usually when the period average method is used, enough material is purchased at the end of each month for the next month's operations, and unless prices for the material remain almost constant from month to month the period average method would show great discrepancies.

Last in, first out. The last in, first out method has been developed recently; its application is in those industries which have a large stockpile of raw materials and use only a small portion of all of the goods which are on hand at any one time. Usually, some of the material is always kept as a stock on which to draw. Examples of industries which may use the last in, first out method are the steel mills and aluminum plants where a large stockpile of ore is always available.

The companies which use the Life method in inventory valuing do so usually for income tax purposes. In periods of rising prices, the Life method tends to keep the inventory value lower than it would be under other methods, thus charging the present high costs of the materials to the Cost of the Goods Sold and decreasing the profit for the period. Under periods of decreasing prices, the profit

would be more than under other methods, but usually if a company is making profits at all under a period of decreasing prices, they are glad to pay income taxes.

For an example of the methods of applying the last in, first out method of inventory valuation, the same data as were used in the above illustrations are employed. The material on hand on June 1, 1943, would be valued at \$1.00 per unit for each of the 100 units. With the addition of 50 units on June 2 at \$1.10, the inventory shows two groups of values:

100 units at \$1.00	\$100.00
50 units at 1.10	55.00

The 50 units which are withdrawn on June 3 are charged out at \$1.10, leaving a balance of 100 units at \$1.00 each. The 50 units added on June 15, at \$1.20 each, leave the inventory as follows:

100 units at \$1.00	\$100.00
50 units at 1.20	60.00
	<u>\$160.00</u>

The 75 units which are withdrawn on July 20 are valued at:

50 units at \$1.20	\$ 60.00
25 units at 1.00	25.00
	<u>\$ 85.00</u>

This leaves a balance of 75 units in the inventory account valued at \$1.00 each, or an inventory valuation of \$75.00.

In comparing the ending inventory by each of the preceding three methods for the same transactions, the following totals are derived:

First in, first out method	25 units at \$1.10	\$87.50
	50 units at 1.20	
Moving Average method, 75 units at \$1.08889		81.67
Last in, first out method	75 units at \$1.00	75.00

Standard Value. The standard price for material valuation is utilized whenever the standard cost system is in use by a company.

The standard price is derived by taking a representative price of past purchases with some consideration of future market conditions. The actual price of materials does not necessarily have to coincide with the standard value, since the materials used are analyzed for price and quantity to determine any variations from the standard. If the price variation is due entirely to the setting up of a standard which is lower than the actual value, this can readily be determined upon analysis of the material variation. Further reference to a standard value for material, as well as a standard value for labor and overhead, will be discussed in the section on standard costs.

Cost or Market, whichever is lower. The Cost and Production Handbook says the following in regard to pricing by the lower of cost or market method:

Companies giving estimates to secure business, and companies in business where selling prices fluctuate from day to day, are required to use replacement values as nearly as possible in cost determination. If materials are on hand and prices have dropped, the market price is used, and difference between cost and market is charged to a special inventory adjustment account. If replacement value exceeds cost price of materials on hand, replacement value is used in a few companies interviewed. In each case, selling prices fluctuated quickly and it was necessary to keep the sales department advised of cost fluctuations based on changes in raw material prices.¹⁰¹

Usually, however, when a company uses the cost or market, whichever is lower method, the material is charged out at cost during the year and revalued at the end of the year to cost or market, whichever is lower.

¹⁰¹ Ibid., p. 1026.

Special inventory control and valuation problem. Other items which affect inventory control and valuation are: freight-in, scrap, and spoiled goods. Freight-in which a purchaser of raw materials pays is a part of the cost of the goods. Obviously, freight-in on factory materials should be charged as a part of the cost of the goods manufactured, whereas freight-in on materials used in selling or administrative supplies is a selling or administrative expense. The problem is to distribute the freight-in to the perpetual inventory. When charged to the individual inventory cards, a proportionate amount is charged to each unit. Sometimes a freight-in account is kept in the factory overhead expense ledger and the freight-in is distributed as an overhead expense on the basis of materials used. Other companies carry freight-in in a separate account, and at the end of each period a proportionate amount is charged to the various inventories.

Scrap is a by-product of manufacturing operations. If the scrap is salable in important quantities, the amount should reduce the cost of the job from which the scrap came, if possible. When it is impossible to credit the scrap to the job, the second best method is to deduct the amount from the factory overhead expenses. Another method is to charge the scrap as a non-operating income.

When goods are spoiled or defective, if they have a scrap value they may be accounted for the same as scrap material, either by deducting directly from the cost of the job produced or deducting from all of the jobs proportionately by crediting to the factory overhead expenses. If the goods have no scrap value, the cost may be borne

by the job or the cost may be distributed to all jobs as an overhead expense by subtracting from the individual job and charging to the overhead account.

Goods in Process Inventories

The goods in process inventories under job-order cost accounting are a cumulation of the costs which are entered on the job-cost sheets. That is, the total of the direct labor used, the direct material used, and an appropriate amount of overhead cost, depending upon the method of distributing the overhead, constitutes the amount of the goods in process inventory. During the next period, the balance of the direct labor, the direct material, and a proportionate amount of overhead is added to complete the cost of the goods.

The problem of valuing goods in process inventories under process cost accounting is dependent upon the determination of the equivalent amount of finished goods that the goods in process stand for. The procedure is developed in the section on process costs.

Under standard costs, the value of the goods in process is based upon the standard which has been set up for material, labor, and overhead. What should be done with the variations in rate and quantity of labor, material, and overhead is subject to various interpretations. Blocker says:

There is no uniformity of opinion among accountants as to the proper disposition of variances resulting from the use of standard costs as general ledger accounting data. One group of writers recommends that debit variances of all types should be transferred directly to Profit and Loss at the end of each month or quarter.

They favor this treatment on the ground that all forms of variances represent conditions of waste, inefficiency, below standard performance, idle time, and changes in business fortune, all of which are not correctly included in manufacturing costs. This policy results in the valuation of work in process inventories and finished goods inventory at standard cost, which is deemed to be a conservative and good business policy because inventories have been depleted of all unnecessary costs resulting from off-standard operations. Furthermore, the presentation of variances as a separate group of items in the profit and loss statement indicates to management the reduction in profits due solely to off-standard plant performance.

A second group of writers advocates that all types of variances, with the exception of material price variances, should be transferred to the Profit and Loss account. In the case of material price variances it is recommended that the debit balance be prorated over inventory of materials in process, finished goods inventory, and cost of goods sold, so that price variances will be included in inventory valuations to be shown on the balance sheet and in the cost of goods sold, which is included in the profit and loss statement. The argument is advanced that price variances between standard prices and actual prices result largely from market and business conditions outside the control of the individual business enterprise and that, therefore, such variances are a legitimate addition to inventory values and to cost of goods sold.¹⁰²

Finished Goods Inventories

The purpose of cost accounting is to determine the cost of manufactured goods. All goods when completed are then stored or sold. The control of the goods until sold is similar to the control of raw materials. Usually separate inventory sheets are kept of the various products and when any of the goods are received from the factory they

¹⁰²John J. Blocker, Cost Accounting, McGraw-Hill Book Company, Inc., New York, 1940, p. 595.

are charged into the finished goods ledger. The valuation of the finished goods in job order cost accounting is a matter of collecting costs for each of the individual jobs produced. Raw material, direct labor, and factory overhead are collected on the job order cost sheets, and then the value of the finished product is transferred to the finished goods ledger. In process cost accounting, the valuation of the inventory is not accomplished until the end of the period, when all of the costs for each of the departments are collected and an average cost of all of the goods produced for the period is determined. In standard cost accounting, all entries into the finished goods ledger are in terms of a standard or average value. The variations from standard are sometimes closed into the goods in process and finished goods inventory account, but usually are kept separate and closed into the profit and loss accounts as separate expenses, other than the cost of the goods sold.

Labor Control and Accounting

In cost accounting, money is paid for human services. The cost of human services is one of the major costs of producing goods. Some of the services performed by the workers necessary for the production of manufactured goods are applied directly to the goods themselves, while other services are applied in a roundabout way. Direct labor is all labor which is used directly in producing manufactured goods, the earnings of the laborer being charged directly to the cost of production. Indirect labor is all labor which is not directly applied in the production of manufactured goods.

In job order cost accounting it is necessary to distinguish between direct labor and indirect labor, because direct labor is a direct charge to the job, while indirect labor is charged to the Factory Overhead and then distributed indirectly to the jobs. Occasionally, however, for accounting purposes, not all labor which is used directly on the job is considered direct, since some labor which is used directly on the job at times may be considered indirect for distribution and analysis. The same is true for indirect labor. It may be wise at times to distribute some labor directly to the job even though it is indirectly applied in the manufacturing process. For accounting purposes, all labor which may be charged directly to the job is direct labor, while all labor which has to be applied by a round-about method is indirect labor. The distinction between direct and indirect labor in process cost accounting is usually not essential, since all labor costs are charged to the process or department in which it is used.

In the last generation or two the accounting for labor has become a complicated process that involves more than mere financial record keeping of the amounts earned. In the last decade, deductions from the employee's earnings as well as contributions by the company for unemployment and old age retirement benefits have become a major consideration. C. F. Sanders, in Management's Handbook, makes the following statement: "No system of cost accounting can be considered as complete that does not provide a check on the efficiency of the

labor employed."¹⁰³

For a record of the efficiency of workers and for obtaining efficient workers, various types of wage systems have been devised. The two basic types of wage systems from which others have developed are the day wages or straight time method, and the incentive systems, of which there are numerous types. The better known of these are:¹⁰⁴

1. Piece rate plan
2. Taylor differential piece-rate plan
3. Merrick Multiple piece-rate plan
4. Gantt Task and Bonus Plan
5. Halsey Plan
6. Bedeaux Point Plan
7. Emerson Efficiency Plan

Day Wage Plan. Under the day wage system, a straight wage is paid to the worker regardless of the amount produced. Usually the pay rate increases after a minimum number of hours or days have been worked during a pay period. The only reward to the employee who continues to do better than others in the same job is an increase in the pay rate. The tendency is, however, for the employees to work at a minimum amount during the pay period instead of at a maximum. When the day wage system is in effect in a plant, if production is increased with the same amount of labor, a de-

¹⁰³L. F. Alford, Editor, Management's Handbook, The Ronald Press, New York, p. 1317.

¹⁰⁴For a complete and detailed explanation of the plans, see Alford, op. cit., pp. 615-656.

crease in the average unit cost of the goods produced results.

Companies usually apply time rates when they have not measured or cannot measure the tasks involved in the job. When employees are above the average in intelligence and pride, it is also possible to employ the day wage system profitably for both the employer and the employee. Because of the stigma attaching to the early application of efficiency methods of wage payments plan, many employees look with disfavor upon any methods other than the straight day wage plan. Since in the early part of the twentieth century many of the employees of plants were forced to increase production without any increase in pay, job standardization and incentive methods of pay are still regarded with disfavor by many employees and managers. If the plant can increase production through job standardization and incentive pay, some of the increase in production should be attributed to the worker, who should be rewarded appropriately. The following incentive plans undertake to combine both increased production and employee recognition.

Piece rate plan. When the piece rate plan is applied, workers are paid in proportion to their productivity. Wages are based on the amount produced when the straight piece rate plan is employed. Whenever the piece rate plan is applied, some knowledge of the normal production of the workers is necessary. The base rate should be in proportion to the performance of the average workers, and the plan should include a time guarantee for beginners.

In terms of the average unit cost, the piece rate plan lowers average unit costs through the per unit cost of overhead, since the

per unit cost of labor remains constant at any rate of output.

The straight piece rate plan is often objected to because of the tendency of the employee to strive for quantity rather than quality, and because of the tendency of the employee to adjust rates if the employees are apparently making excessively high wages.

The Taylor Differential Piece-Rate Plan. The Taylor plan undertakes to encourage exceptional workers through an increase in rates after a standard in production has been reached. It attempts to discourage poor workers by not offering any guaranteed wage except that earned by production. A standard output per period, usually a model type of standard, is derived by time and motion studies. Any work under this standard is paid at the regular piece rates. When the worker exceeds the standard, an increase in pay per piece is given him. The Taylor Differential Piece Rate Plan tends to discourage the poor workers but encourages the very good workers, as the good workers would make the greater wages.

The Merrick Multiple Piece-Rate Plan. The Merrick plan is identical with the Taylor plan with the exception of an additional rate for exceptional cases such as apprentice workers. Thus instead of two rates, one for the substandard and one for the above standard, there are three rates—one for the learner, one for the below standard, and one for the above standard.

The Gantt Task and Bonus Plan. The Gantt plan resembles many other combination time and piece-rate plans. A standard time is determined for each operation. The workers who complete the opera-

tion within the standard time or under the standard time are given the regular full time pay and in addition are allowed a bonus for above standard performance, usually between 20 and 50 per cent of the standard day wage. The poor workers always make the full day's pay while the exceptional workers make an additional bonus for completing the task in superior time.

The Halsey Plan. Under the Halsey plan, a regular time wage is paid, any savings made by the employee by completing the job in a shorter time than the standard being compensated for by a bonus equal to about two-thirds of the value of the time saved. When a plant employs all hand labor, the Halsey plan works well, but when production is increased by scientific process, the worker demands that he be given his share of the increase. When a method of valuing the output of labor has become more definite, then the Halsey plan will be of greater importance.

The Bedeaux Point Plan. Under the Bedeaux Point System, points are the basis for the standard task which can be accomplished in an hour. Usually 60 points are given as the standard work accomplished in an hour. When more than the standard work is done in the sixty allotted minutes, additional points are allowed for the above standard work. The regular wage is paid for all time up to standard and a bonus is paid for all hours above standard. The Bedeaux system is complicated and expensive to install and operate, but is effective for justly compensating good and bad workers.

The Emerson Efficiency Plan. Under the Emerson plan a guaranteed

wage is provided, and in addition a graduated scale is provided whereby workers are paid a bonus in terms of percentage of efficiency of standard. The bonus scale usually starts when the worker is within 66.7% of the 100% standard, and the percentage of bonus increases with each additional three to five percent of standard reached.

Social Security and Income Tax Accounting

Some of the newer aspects of payroll accounting deal with the deductions for old age insurance, unemployment insurance, and income tax on the employee's wages. Blocker describes the social security taxes as follows:

There are three social security taxes for which records must be provided. The federal old-age and survivors insurance tax applies to both employers and employees of business enterprises covered by the act. Provision is made for two distinct taxes collected from the employer as a single payment. An excise tax is levied on all employers and an "income tax" is levied on employees to provide a fund from which insurance benefits may be paid to those individuals or their survivors who qualify under the provisions of the act. The Federal unemployment compensation tax applies only to employers of eight or more employees in covered employments. It is an excise tax levied on employers, the proceeds of which are used to induce states to enact unemployment compensation laws and to collect the funds necessary to pay the cost of administration of state laws. There is no provision for specific taxes to finance Federal grants ^{pay} to assist states in their grants to needy people.¹⁰⁵

The rate for the old age insurance is one per cent, for both employee and employer, of the employee's wage up to and including

¹⁰⁵John G. Blocker, *op. cit.*, pp. 121-122.

\$3,000. This rate is supposed to change in 1943 but as yet Congress has not approved any change in the rate. The Federal Unemployment compensation tax is paid by the employer, being based on the employee's wages. The total tax at the present time is three per cent; one-tenth of the three percent, or three-tenths of a percent, goes to the federal government; the balance of 2.7% goes to the state unemployment compensation division. Of all of the taxes for old age and unemployment, the employer pays 3.7% of the employees wages, the employee one per cent. In some states, the state law requires the employee to contribute for unemployment taxes; however, that is not the general rule.

Stabilization of employment is the basis for the unemployment taxes, so as part of the tax law, a provision has been inserted lowering the tax rate on specific industries which do not have many deductions from the fund provided by the payment of the taxes. Thus the provisions of the tax tend to reward employers who enjoy stable employment conditions.¹⁰⁶

In 1943 the Federal government passed a withholding tax law, pertaining to the withholding of taxes on incomes of wage earners. Withholding applies to all remuneration paid to an employee, including salaries, wages, fees, commissions, etc., whether paid in cash or other than cash. If paid other than in cash, the fair

¹⁰⁶ As each state law differs in respect to many of the provisions of the tax for unemployment stabilization, it is necessary to consult the laws of each state for specific provisions.

market value of the item is considered the amount of the wages. The employer may follow either of two patterns to compute the amount to be withheld, i.e., he may withhold 20% of the excess of each payment above a stipulated sum for each type of workers, or he may use bracketed tables which show the tax already computed according to family classification of worker.

In addition to the record of the various taxes on wages, the employer must keep records of the employees' wages as required by the Wage-Salary Stabilization Law. This law provides for the stabilization of wages and salaries, depending upon the amount as of October 3, 1942, or October 27, 1942. Either the War Labor Board or the Commissioner of Internal Revenue has jurisdiction over an approved wage or salary increase, depending upon the classification.

Overhead Accounting

Overhead expenses are all of those costs necessary in the production of goods which cannot be apportioned directly to the product. The costs of many materials which are employed in the production of goods can be charged directly to the job on which they are used. The same is true of many types of labor. The workers who are employed directly in producing the articles have their wages charged directly as a part of the cost of the job. Many types of materials, however, cannot be charged directly to one job, since the materials are consumed in many jobs. Such items as sandpaper used to finish wooden desks, oil to lubricate the machinery, and tools to repair

machinery cannot be directly charged to specific jobs. Neither can the labor cost of janitors to clean the buildings, foremen to supervise the work, or repair men to keep the machines in serviceable condition be apportioned directly to any specific jobs. In addition, such items as depreciation, taxes, insurance, patents expense and various other costs which are fixed and recur from month to month cannot be charged directly to specific jobs. Each of the above items is an overhead expense.

Factory overhead has been designated in many different ways. The word "overhead" is all inclusive, meaning all expenses which are not directly chargeable to specific jobs. In a manufacturing concern there must be a distinction between the overhead used in manufacturing the goods and the overhead used in selling the goods or administering the financial affairs of the concern, so that an accurate cost of manufacturing the goods is determined. To distinguish the overhead used in manufacturing from that used in selling, "manufacturing expenses," "manufacturing overhead," "factory overhead," "burden," and other similar titles have been employed. In this paper, the term "factory overhead" is employed to include all of the indirect expenses of manufacturing goods, while "manufacturing expenses" includes all expenses of manufacturing goods other than indirect labor, or indirect material, such as depreciation, taxes, insurance, and rent.

To complete the determination of the cost of manufacturing goods, it is necessary to add the factory overhead costs to the

direct material and direct labor costs. The chief methods chosen to allocate arbitrarily factory overhead and expenses are:

1. By direct labor cost
2. By direct labor hours
3. By machine hours
4. By direct materials cost
5. By units produced
6. By total of direct labor and raw materials cost

Direct Labor Cost. Whenever wages vary in direct proportion to the output of goods produced, it is practicable to allocate the amount of overhead to each article in proportion to the amount of labor cost involved in producing the articles. For example, if the overhead in a plant is \$10,000 and the direct labor cost is \$10,000, for each dollar of direct labor there is also an additional dollar allocated for overhead. If in the department one job involves a total direct materials cost of \$150 and a total direct labor cost of \$100, the cost of the job is:

Direct Material	\$150.00
Direct Labor	100.00
Factory Overhead (\$1.00 for each \$1.00 of Direct Labor)	<u>100.00</u>
Total Cost of Job	<u>\$350.00</u>

The direct labor cost system is highly successful only when one product or products of similar construction are made. If several products are made involving varying types of labor, gross errors in

the computation of the overhead may result. When the products made demand a high percentage of skilled labor and hence high labor costs, a greater proportion of overhead must be charged than if the article involves a low labor cost and high overhead with a less proportion of overhead because of the mechanization of production. Unless the same product is produced in each department, the overhead may be over or under-stated unless careful analysis of the labor cost is considered.

Direct Labor Hours. The amount of overhead may be distributed in proportion to the number of man-hours applied instead of the dollar value of the labor employed on the production of the department. Both methods are based on the idea that overhead expenses of making goods are in direct proportion to the labor consumed. Under the man-hour method, no differences in varying rates of pay are taken into consideration in the application of the overhead, since the distribution of the overhead is on the basis of the number of hours that the employees are on the job. For example, if the Factory Overhead expenses are \$10,000, the direct labor cost is \$10,000 and the number of direct labor hours is 20,000, for each direct labor hour employed on any one job fifty cents of overhead is charged. (Factory Overhead Expenses, $\$10,000 \div 20,000$ direct labor hours = \$.50 per direct labor hour.)

If Job 1 involves \$150.00 of direct materials cost, \$100.00 of direct labor cost and 195 direct labor hours employed, the cost of the job is:

Direct Materials	\$150.00
Direct Labor	100.00
Factory Overhead (\$.50 x 195 direct labor hours)	<u>97.50</u>
Total Cost of Job	<u><u>\$347.50</u></u>

Whenever Factory Overhead is distributed on the basis of direct labor hours, the cost department has an additional record to keep-- the number of direct labor hours. Little additional cost is incurred, however, since the number of direct labor hours may be ascertained at the same time that the labor cost is determined.

Machine Hours. In a plant having a high proportion of machine production, it is possible to distribute the factory overhead on the basis of the number of hours the machines are used on individual jobs. If the plant as a whole has 100,000 hours of machine use during the month and the factory overhead is \$5,000, then for each hour that the machines are employed on a job, 5¢ must be charged for overhead. To determine the cost of a job which has raw material costs of \$25.00, direct labor cost of \$10.00 and the factory machines are employed for 50 hours on the job, the following analysis applies:

Direct Materials	\$25.00
Direct Labor	10.00
Factory Overhead (50 hours at 5¢ per hour)	<u>2.50</u>
Total Cost of Job	<u><u>\$37.50</u></u>

Direct Materials Cost. When overhead is distributed according to the raw materials used, a ratio is found between the amount of overhead expense and the amount of direct raw materials consumed in each department. Overhead is then distributed to each job according to the predetermined ratio in proportion to the raw materials charged to each job. For example, if the total raw material cost in a department is \$15,000 and the factory overhead for the department is \$10,000, then for every dollar's worth of raw material consumed on a job, factory overhead of $66\frac{2}{3}\%$ must be charged additionally to the job. If Job X has direct materials cost of \$150.00 and direct labor of \$100.00, the cost of the job is:

Direct Material	\$150.00
Direct Labor	100.00
Factory Overhead ($66\frac{2}{3}\%$)	<u>100.00</u>
Total Cost of Job X	<u><u>\$350.00</u></u>

Distributing factory overhead by the direct materials cost method is not very satisfactory in a plant in which raw material prices fluctuate violently and frequently.

Units Produced. The unit method of distributing overhead is simple, because factory overhead is distributed on the basis of the number of units produced. It is of necessity applied only in a plant manufacturing one or more quite similar articles, since the units must be equal to incur a proportionate share of the overhead. For example, if the overhead for the entire department is \$10,000

for the month and there are 100,000 units produced, each unit is charged overhead expense of ten cents. If a job has direct labor of \$75.00, direct material of \$50.00 and there are 1,500 units produced, the cost of the job is as follows:

Direct Material	\$50.00
Direct Labor	75.00
Factory Overhead (1,500 units at 10¢)	<u>150.00</u>
Total Cost of Job	<u>\$275.00</u>

Total Direct Labor and Raw Material Cost. Distributing overhead by the total of the direct labor and raw material cost is supposed to eliminate the bad points noted in the separate use of either the labor cost method or the raw material cost method. To employ this method, a ratio is computed between the total cost of both the raw materials and the direct labor to the total amount of the overhead. Overhead is then distributed to each job on the basis of the computed ratio in proportion to the total amount of direct labor and material used on the job. If the total direct labor in a department is \$10,000 and the direct material is \$5,000, when the factory overhead is \$7,500, fifty cents of factory overhead is distributed to each job for each dollar of direct material and direct labor cost. (Direct material, \$5,000, plus direct labor, \$10,000, divided by factory overhead, \$7,500). If a job requires \$30.00 of raw materials, \$60.00 of direct labor, the cost is:

Direct Material	\$30.00
Direct Labor	60.00
Factory Overhead (\$90.00 x 50%)	<u>45.00</u>
Total Cost of Job	\$135.00

In addition to the general methods of distributing factory overhead expenses discussed above, there are special problems which always exist due to variations in the manufacturing plant. The problem of overhead accounting is to determine the correct amount of overhead in each manufacturing department. There are always service departments in a manufacturing plant whose costs must be distributed to the productive departments before the total cost of factory overhead in the productive departments can be determined. There are two general methods of distributing the service departments costs to the productive departments:

1. By closing the service departments costs into other service departments as well as into the productive departments.
2. By closing the service departments costs directly into the productive departments.

When the service departments costs are distributed among the other service departments, it is important to know how much service has been rendered to the other departments. The costs of the department which renders the greatest amount of service to all of the other departments are usually distributed first; the cost of the department which renders the next amount of service, including the amount from the first department, is then distributed to the remaining

service and productive departments. By the above method, each service department receives charges from the departments which render services greater than the department in question renders, but is not charged with any amount from the department which provides less services than the department in question. It is possible, through algebraic treatment, to distribute the proportionate share of each service department to all other service and productive departments; however the algebraic method is seldom used because of the complications involved in the mathematical treatments of the distribution. Little benefit can be derived from such fine treatment, and the cost of such a method usually is greater than any benefit secured.

The simpler plan is to distribute the service departments directly into productive departments without going through any other service departments. While not as accurate as the method of distributing the service departments among other service departments, the method of distributing service departments directly to the productive departments is often employed, and unless circumstances demand a closer analysis of service department expenses, is just as good for practical purposes.

The methods of distributing the service departments depend upon the type of service rendered by the department. The following are some of the bases employed for distributing service department expenses:¹⁰⁷

¹⁰⁷Clarence L. Van Sickle, Cost Accounting, Harper & Brothers, New York, 1938, pp. 298-299.

1. Arbitrary percentage of amount.
2. Statistical record.
3. Number of factory employees.
4. Number of total hours worked:
 - a. Total man hours (direct and indirect labor).
 - b. Total machine hours.
5. Number of direct labor hours.
6. Meter measurement.
7. Horse-power rating.
8. Floor area.
9. Cubic-foot space.
10. Radiation surface.
11. Valuation of equipment.

In addition to distributing the service departments to the productive departments, it is necessary to have some arbitrary basis for the distribution of the fixed expenses to each department. The above bases listed for the distribution of service department expenses are also used as bases for the distribution of fixed expenses such as depreciation, rent, light, heat, power, and taxes. The individual cases are usually reviewed for the most exact method of distributing the costs for the least amount of expense.

Ordinarily there are two different types of overhead expenses, fixed and variable. At different rates of production the fixed expenses, such as rent, insurance, taxes, interest, and depreciation, are applied at the same rate, thus charging more for each unit when the output is not very large. This causes a variation in the cost of the finished products for reasons beyond the control of the company. To take care of this situation so as to arrive at what may be considered true costs at any production capacity, the procedure of charging a normal amount of overhead at any capacity is followed. A normal amount of hours or of production at which the company will

run under average circumstances is decided upon. The amount of fixed and variable overhead divided by the number of hours or by the production gives the normal rate per hour or product to charge out to the job as factory overhead. The variable overhead is not changed on a per unit basis no matter at what capacity the plant operates, but the fixed amount varies with the output. In the accounting records, the difference between the total fixed overhead and the standard amount of overhead at the production rate is usually taken care of in a special account. The analysis of the variation between the actual and the standard overhead shows the expenses due to subnormal operating conditions. Standard cost accounting develops this process to its highest degree, having a standard not only for overhead, but also for raw materials and direct labor.

CHAPTER XII

STATISTICAL METHODS FOR COST ACCOUNTANTS, CONTINUED

Process Costs

The accounting for process costs is in many ways simpler than the accounting for job order costs. Process costs are especially valuable in industries which are of the continuous production or mass-production type. By segregating the expenses of producing goods for a department or for a process, the average cost of producing those goods may be readily determined if the total output for the department is known. For example, if the costs involved in producing 10,000 units of a certain type of goods are:

Materials	\$10,000.00
Labor	15,000.00
Other Manufacturing Expenses	<u>7,500.00</u>
Total Cost of Production	<u>\$32,500.00</u>

then the average cost of producing a unit can be determined by dividing the total cost (\$32,500.00) by the total output (10,000 units), which will give an average unit cost of \$3.25.

In process cost accounting it is necessary to break down the work into steps, departments, or processes. Since it is usually

unnecessary to charge indirect labor and indirect material and manufacturing expense into an overhead account before distribution, process cost accounting does not offer the problems of overhead distribution which are confronted in job order cost accounting. All of the costs necessary for the work done in one department or on one process are charged directly into the departmental account for the period involved. At the end of the period, all that is necessary to determine the average cost per unit is to discover how many units have been produced and how much of the raw materials, labor, and manufacturing expenses have been left in the goods in process. Thus, the main problems that are encountered in process cost accounting are:

1. Determination of units of equivalent production--total number of finished products plus a number of units equivalent to finished goods represented by the goods in process inventory.
2. Valuation of the goods in process inventory.

In determining the units of equivalent production, it is necessary to know the stage of production. For example, if a company has 50,000 units which are fully completed during a period and 10,000 units which are one-half completed, the total production is 55,000 units, if production is stated in terms of finished goods. That is, 10,000 units one-half completed is the same as 5,000 fully completed, and when added to the fully completed goods, the equivalent of 55,000 is found to be the result.

To show the statistical methods involved in computing average costs by the process cost method, two illustrations are given. The

first illustration shows the methods of computing equivalent production and the valuation of the goods in process inventories when there is only one department and there is no beginning goods in process inventory but there is an ending goods in process inventory. The second illustration shows the methods of determining unit costs when there are beginning and ending goods in process inventories and three departments.

Process Costs -- Illustration One:

Assume that a company manufactures a single product which is completed in a factory operated as one department. The raw materials, labor, and overhead are all applied in proportion to the stage of completion of the goods. The Factory Production Report shows the following information:

Production Report

Department A

For month of July, 19--

In Process, beginning of month	<u>none</u>
Finished during the month	<u>20,000 units</u>
In Process, end of month	<u>10,000 units</u>
Estimated completion	<u>one-half</u>

Production Costs

Cost from preceding period	<u>none</u>
Materials	<u>\$10,000</u>
Labor	<u>\$10,000</u>

Factory Expenses \$ 5,000

Total Costs \$25,000

Unit Output for the Month: Finished Unit Equivalent

Placed in process and finished 20,000

In process end of month, (10,000
units 1/2 completed) 5,000

Equivalent production 25,000

Unit Cost for the Month:

$\$25,000 \div 25,000 \text{ units} = \1.00 per unit

The 10,000 units in process at the end of the month are considered one-half completed; that is, the equivalent of 5,000 units totally completed. The value of the goods in process inventory is determined from the cost per unit as determined above. Since the goods in process are estimated to be one-half completed, their value is \$5,000, that is, \$.50 per unit ($\$1.00 \times 1/2$) for the 10,000 units.

Process Costs — Illustration Two:

Determining costs of production by processes is much more complicated when the material, labor, and overhead are not added proportionately to completion of the goods and when there are both beginning and ending inventories. The procedure is still more involved when there is more than one department. In the following illustration a manufacturing company shows the computation of the departmental unit costs, equivalent production, and goods in process inventories for each of three departments. In Department One, all

of the materials are added at the beginning of the process. In Department Two, 50% of the materials is added at the beginning of the process, and 50% is added when the goods are one-half completed. In Department Three, all of the materials are added at the end of the process. In all of the departments, labor and overhead are added uniformly during the processing period. There is also a loss in units because of evaporation in Department Three. The following are the production reports and cost for each department.

Production Report

Department One

For Month of December, 1943

Quantity

In Process, beginning of month	<u>2,000 units $\frac{1}{2}$ completed</u>
Placed in Process during month	<u>25,000 units</u>
Finished and transferred during month	<u>22,000 units</u>
In process end of month	<u>5,000 units, $\frac{3}{4}$ completed</u>

Costs

Material	\$6,250.00
Labor	3,612.50
Factory Overhead Expense	<u>2,575.00</u>
Total Manufacturing Costs	<u>\$12,437.50</u>
Goods in Process 12/1	<u>750.00</u>
Total Costs Dept. One	<u>\$13,187.50</u>

Production Report

Department Two

For Month of December, 1943

Quantity

In Process, beginning of month 4,000, 1/4 completed
 Placed in Process during month 22,000
 Finished and transferred during month 20,000
 In Process end of month 4,000, 1/4 completed, 2,000, 3/4 com.

Costs

Material	\$24,200
Labor	10,750
Factory Overhead Expense	4,300
Total Manufacturing Costs	<u>\$39,250</u>
Goods in Process beginning of month	4,700

Production Report

Department Three

For Month of December, 1943

Quantity

In Process, beginning of month 6,000, 1/2 completed
 Placed in process during month 20,000
 Finished and Transferred during month 20,000
 In Process end of month 5,000, 1/2 completed

Costs

Material	\$15,000.00
Labor	11,700.00

Factory Overhead Expenses	5,850.00
Total Manufacturing Costs	<u>\$32,550.00</u>
Goods in Process beginning of month	\$16,050.00

Department One:

Below is illustrated the method of computing the unit value for the material and labor and overhead for Department One:

Unit Cost of Materials:

Material Cost	\$6,250.00
Equivalent units of material (All material is added at the beginning of the process)	25,000.00
Material Cost per unit ($\$6,250 \div 25,000$) = \$.25	

Unit Cost of Labor and Factory Overhead:

Unit Output for the Month	Equivalent Units
Goods in Process, beginning of month (2,000 units - 1/2 completed)	1,000
Goods started and finished during month	20,000
Goods in Process, end of month (5,000 units - 3/4 completed)	<u>3,750</u>
Total Equivalent Units	<u>24,750</u>

Labor and Factory Overhead Cost:

Labor cost	\$3,612.50
Factory Overhead Cost	<u>2,575.00</u>
Total Labor and Factory Overhead	6,187.50

Unit Cost of Labor and Factory Overhead Expenses:

$$\$6,187.50 \div 24,750 = \$.25$$

Total cost of goods worked on in Department One:

In Process beginning of month (2,000 units - 1/2 completed) \$ 750.00

Added during month

Material (All material added last month) none

Labor and Factory Overhead
(2,000 units at 12½¢ - ½ at 25¢) 250.00

Total Cost 1,000.00

Placed in process and finished during month:
(20,000 units)

Material added (20,000 x 25¢) \$ 5,000.00

Labor and Factory Overhead (20,000 at 25¢) 5,000.00

Total Cost 10,000.00

Cost of Goods Finished and Transferred to Dept. Two 11,000.00

In Process, end of month: (5,000 units,
3/4 completed at 25¢)

Material (5,000 units all material added) \$ 1,250.00

Labor and Factory Overhead (5,000 units,
3/4 completed at 25¢) 937.50

Total Cost 2,187.50

Total Costs distributed in Department One \$13,187.50

Materials \$ 6,250.00

Labor 3,612.50

Factory Overhead 2,575.00

Total Manufacturing Cost \$12,437.50

Goods in Process, beginning
of month 750.00

Total Costs in Department One during Month \$13,187.50

The material in Department One is all added at the beginning of the process, so that the equivalent units of material are equal to the number placed in process, 25,000. When divided into the total material costs of \$6,250, the unit cost of material is found to be 25¢.

The labor and factory overhead costs are added uniformly during the processing so that the equivalent units of production of labor and overhead are computed similarly to Illustration One. There was a beginning inventory of 2,000 units, one-half completed, and the other one-half of the work is completed during the present month. Adding one-half of the labor and overhead to 2,000 units is equivalent to adding all of the labor and factory overhead to 1,000 units. All of the labor and factory overhead is added to the 20,000 units started and completed this month. In process cost accounting, it is assumed that the units first started are the ones first completed; so to determine the number of units started and finished during the present month, subtract the beginning units of inventory 2,000 from the number of units finished and transferred, 22,000. The ending inventory has 5,000 units which are three-fourths completed, to which labor and factory overhead costs have been added uniformly in the production process. This is equivalent to adding all of the labor and factory overhead to 3,750 finished units. The total equivalent units of labor and factory overhead, 24,750, divided into the total labor and factory overhead costs of Department One, \$6,187.50, results in a unit cost of labor and factory overhead of 25¢. The total cost per unit in Department One is equal to \$.50 (material 25¢ added to the labor and overhead of 25¢ = \$.50).

Department Two. To ascertain the unit value for materials and the unit value for labor and factory overhead expenses for Department Two, together with a valuation of the goods in process inventory, the following method is employed. In Department Two fifty per cent of the materials is added at the beginning of the process, the balance being added when the goods are one-half completed.

Unit Cost of Materials:

Material Cost		\$24,200
---------------	--	----------

Equivalent Units of Material:

Goods in Process Inventory, beginning (4,000 units, 1/4 completed, 1/2 of the material added this month)	2,000	
--	-------	--

Goods started and finished this month (22,000 placed in process, 6,000 ending inventory)	16,000	
--	--------	--

Goods in Process Inventory, ending (4,000 one fourth completed, 1/2 of material added)	2,000	
(2,000 3/4 completed, all material added)	<u>2,000</u>	<u>4,000</u>

Equivalent Units of Material		22,000
------------------------------	--	--------

Unit cost of material, $\$24,200 \div 22,000 \text{ units} = \1.10

Unit Cost of Labor and Factory Overhead:

Labor and Factory Overhead Cost

Labor	\$10,750
Factory Overhead	<u>4,300</u>

Total Cost of Labor and Factory Overhead	\$15,050
--	----------

Equivalent Units of Labor and Factory Overhead:

Goods in process, beginning (4,000 units - 3/4 completed this month)	3,000
---	-------

Goods started and finished this month	16,000
---------------------------------------	--------

Goods in process, ending	
4,000 units, 1/4 completed	1,000
2,000 units, 3/4 completed	<u>1,500</u>
	<u>2,500</u>

Equivalent Units of Labor and Factory Overhead	<u>21,500</u>
--	---------------

Unit Costs of Labor and Factory Overhead
 (\$15,050 ÷ 21,500 units) = \$.70

Total Costs of Goods Worked on in Department Two:

In Process, beginning of month - 4,000 units	\$4,700	
Costs added during month		
Material (4,000 × 1/2 × \$1.10)	\$2,200	
Labor and Factory Overhead		
4,000 × 3/4 × .70	<u>2,100</u>	4,300
		\$ 9,000
Goods started and finished this month, 16,000		
Costs in Dept. One at 50¢		8,000
Costs added during month		
Material at \$1.10	17,600	
Labor and Overhead at \$.70	<u>11,200</u>	36,800
Costs of Goods finished and transferred to Department Three:		\$45,800
Unit Cost at		
is \$2.29 (\$45,800 ÷ 20,000 units)		
Goods in Process Inventory, ending, 4,000 units		
1/4 completed, 2,000, 3/4 completed		
Cost in Dept. One at \$.50		\$3,000
Cost in Dept. Two:		
Material		
4,000 (1/2 material added at \$1.10)	\$2,200	
2,000 (all material added at \$1.10)	<u>2,200</u>	
Total material		4,400
Labor and Factory Overhead		
4,000 (1/4 completed at \$.70)	700	
2,000 (3/4 completed at \$.70)	<u>1,050</u>	
		1,750
Total Cost of Goods in Process end of month		<u>9,150</u>
Total Cost distributed in Dept. Two during month		<u>\$54,950</u>
Materials	24,200	
Labor	10,250	
Factory Overhead	<u>4,300</u>	
Total Manufacturing Expense		39,250
Goods in Process, beginning of month	4,700	
Goods received from Dept. One during month	<u>11,000</u>	11,000
Total Costs in Dept. Two during month		<u>\$ 54,950</u>

Since the units of material and thus the material cost are added in different proportions than the labor and factory overhead, it is necessary to determine how many equivalent units of material are used in addition to the equivalent units for the labor and the factory overhead. When one-half of the units of material is added at the beginning of the process, any units less than one-half completed have one-half of the units of materials and as a result material costs added. Any of the units one-half or more completed have all of the materials and material costs added. In the beginning inventory, one-half more of the material must be added, although three-fourths of the labor and overhead costs are needed to complete the job. Thus, completing four thousand units which have one-half of the material cost added is the same as adding all of the material cost to two thousand completed units. In the ending goods in process inventory, since four thousand units are one-fourth completed, one-half of the materials cost has been added, or an equivalent number of two thousand fully completed units. The two thousand units which are three-fourths completed have had all of the material cost added because the last material was added at the half-way mark. The analysis of the labor and the factory overhead is the same as for Department One.

The unit cost of goods manufactured in Department Two is a combination of the costs of Departments One and Two. The total cost of the goods fully manufactured and transferred to Department Three is \$45,800 for the 20,000 units transferred, or \$2.29 each. When one considers that the per unit cost in Department One is 50¢ and

that in Department Two is \$1.80 (Material \$1.10 and Labor and Factory Overhead \$.70), without further analysis one may think that the per unit cost of the goods manufactured in Department Two should be \$2.30. It must be remembered, however, that the goods in process inventory for the preceding month may not have the same per unit costs for work completed last month as for work completed this month, which causes the per unit costs to be different when a weighted average of the two months is taken.

Department Three. The computations necessary to find the equivalent units, unit value for the materials, the unit value for the labor and factory overhead, and the values of the inventories in process, and the value of the finished goods are given below. In Department Three, all of the units of material and material costs are added at the end of the process. The labor and the factory overhead expenses are added in proportion to production. There is also loss of units due to evaporation in this department.

Unit Cost of Materials:

Equivalent units of material:	
Goods in process beginning of month	\$ 6,000
(all material added at end)	
Placed in Process and finished during month	14,000
Goods in process end of month	
(no materials added)	
Equivalent units of material	<u>\$20,000</u>
Material Cost	15,000
Unit cost of materials, \$15,000	
÷ 20,000 units = .75	

Unit Cost of Labor and Overhead:

Equivalent units of Labor and Overhead:	
Goods in process, beginning of month,	3,000
6,000 units $\frac{1}{2}$ completed this month	
Placed in process and finished during month	14,000

In process end of month, 5,000 units	
$\frac{1}{2}$ completed	<u>2,500</u>
Total Equivalent Units	19,500

Labor and Factory Overhead, Cost	
Labor	\$11,700
Factory Overhead	<u>5,850</u>
	\$17,550

Unit Cost of labor and factory overhead:
 $\$17,550 \div 19,500 \text{ units} = \$.90$

Total costs of goods worked on in Department	
In process beginning of month, 6,000 units	\$16,050
Costs added during month:	
Material (all material added) at .75	4,500
Labor & Factory Overhead $\frac{1}{2}$ completed	<u>2,700</u>
(6,000 x $\frac{1}{2}$ x .90)	\$23,250.00

Goods started and finished this month: 14,000	
Costs in Dept. One and Two (14,000 units)	
at \$2,410.5263*	\$33,747.37
Costs added during month	
Material 14,000 units at .75	10,500.00
Labor and Factory Overhead	12,600.00
14,000 units at .90	23,100.00
	<u>56,847.37</u>
Total costs of goods finished and transferred to stock:	80,097.37

In process end of month, 5,000 units, $\frac{1}{2}$ completed	
Costs in Dept. One and Two at \$2,410.5263	12,052.63
Material Costs (all material added at end of process)	
Labor and Overhead (5,000 x $\frac{1}{2}$ x .90)	<u>2,250.00</u>
	<u>\$14,302.63</u>
Total Costs distributed in Dept. Three	\$94,400.00

Total Costs in Dept. Three for month	
Materials	\$15,000
Labor	11,700
Factory Overhead Expenses	<u>5,850</u>
Total Costs for month	32,550.00
Goods in process beginning of month	16,050.00
Transferred from Dept. Two during month	<u>45,800.00</u>
Total Costs Accounted for	<u>\$94,400.00</u>

*Loss in units increases unit costs from previous departments.

In Department Three, since all materials are added at the end of the process, no material costs are incurred until the goods are finished. The department has a shrinkage of units and the shrinkage is assumed to take place in the goods that are transferred from the previous department this period. That is, during the month 20,000 units are transferred from the preceding department. There are 6,000 units at the beginning of the month, making a total of 26,000 units to be accounted for. However, 5,000 units are left in the goods in process at the end of the month while only 20,000 were finished and transferred during the month, leaving a shortage of 1,000 units. This shortage is automatically cared for if the equivalent units finished during the month are computed by subtracting the beginning number of units, 6,000, from the number of units finished and transferred to stock. The per unit costs from the preceding department will have to be increased, however, and since there are only 19,000 units left from the 20,000 transferred from Department Two, the cost is raised from \$2.29 per unit to \$2.41052634 per unit (\$45,800 cost of goods transferred into Department divided by 19,000 units).

The increased value per unit is distributed to the 14,000 units which had been started this month and finished and transferred to stock and the 5,000 units which remain on hand. No additional charge for shrinkage need be made for the beginning goods in process inventory because the value was increased in the preceding month proportionately to the increased unit cost for the preceding month.

When shrinkage or overage of units in a particular process occurs at a known rate, it is possible to also deduct from the

beginning inventory the known amount of shrinkage for the period. Under this method, the shrinkage is absorbed by the beginning goods in process inventory, the goods started and finished during the present period, and the goods in process at the end of the present period.

When two or more products are completed in the same process, some method of arbitrarily weighting each product is usually devised. From a theoretical standpoint, the weights should be in proportion to the selling value of the products. In determining valuations of inventories for joint cost products, the Bureau of Internal Revenue recognizes sales value as an appropriate basis for allocating costs to the units of output.

CHAPTER XIII

STATISTICAL METHODS FOR COST ACCOUNTANTS, CONTINUED

Standard Costs

Standard cost accounting is often called budgeting. This is not an entirely true statement, since budgeting may be practiced in financial and governmental accounting as well as in cost accounting. Standard cost accounting is accounting by comparisons with standards. The standards are predetermined so that in the operation of the system all of the expenses of a certain job or process are charged at standard rates and quantities. Any variations of the total of the standard price and quantities from the actual price and quantities are noted and the reasons sought for the variations. excess prices of material or the use of too much material, excess labor rates or labor time, and varying degrees of operations cause variations from the standards which are set. Variations due to charging a full amount of overhead at less than normal capacity have been an incentive to the development of standard cost accounting. D. R. Scott says:

Another and somewhat similar example arises in the treatment of overhead costs. When the output of an enterprise is irregular, the idle capacity of a plant must be carried through slack periods. This extra capacity is provided for the production of peak periods. Hence

the cost of carrying it through slack periods is not a cost of operations of those periods. Cost accounting undertakes to meet this situation by charging overhead against operations and productions at standard rates, thus affording standard costs for products of both slack and peak periods.¹⁰⁸

The methods of accounting for job order costs or process costs are the bases for the standard cost system. Standards are computed for labor, material, and overhead and are charged to the job or process instead of charging the actual amounts which are used. Standard costs may be kept separate from the regular job order or process costs mainly for statistical analysis. Usually, however, the standard cost system is a part of the double entry accounting system.

The procedure of ascertaining the standard to be applied in the system varies. Charles F. Schlatter says in regard to the determination of standards:

It will be remembered that even among those cost accountants who subscribe to the theory of normal burden there is a difference of opinion as to the strictness with which the normal burden rate should be set. There are those who attempt to set a rate which will absorb all fixed expenses into production over a long period of time. These define "normal" as "average." And, there are those who define "normal" as "standard" and therefore, set the burden rate on a basis of what production should be at practical capacity, thus obtaining a rate so low over a long period of time, as well as in most of the shorter periods, there is nearly always absorbed burden representing the fixed expense of idle capacity. As might be expected, these differences of opinion are also found when standards for materials and labor are considered.

¹⁰⁸D. R. Scott, Journal of accountancy, Volume 67, No. 2, Feb. 1939, p.

Some of the most ardent advocates of standards believe that standard cost should be the lowest possible cost with which the work can be done with the facilities and methods in use in the plant. Naturally one would expect to find the advocates of the practically capacity burden rate in this group. Speaking in terms of golf, one may say that such a standard is "par."

Other manufacturers and cost accounts believe that the standards should be more lenient; that is, they believe standards should not represent the lowest possible cost but a cost that can be more easily attained. For example, they set as the standard of labor performance, the rate of performance, not of the best workman nor of a hypothetical workman, but of a good workman, but little, if any, above the average in ability. One expects to find in this group the advocates of the "average" capacity burden rate. Again speaking in terms of golf, one may call this standard, "bogey."¹⁰⁹

Material Standards

To derive a standard for material costs, average prices for some basic month, year, or average of years may be employed. The main reason for the setting of a standard is to obtain data for comparison of the relative position of the company at the two different rates--the standard with the actual. Any reasonable figure can be applied as a standard for comparative purposes. To derive a standard price for materials, materials must also be standardized as to quality, as it would be impossible to use one standard rate for varying grades of materials. In addition to the price of materials, it is also necessary to determine the quantity of materials employed on any one job or process, since price times the quantity equals the

¹⁰⁹Charles F. Schlatter, Advanced Cost Accounting, John Wiley and Sons, Inc., New York, 1939, p. 124.

total value of the materials used. Quantity standards are usually determined by the engineering department. The size, shape, and quality of the various articles being produced determine the amount of materials necessary for their construction.

Labor Standards

Labor standards also take into consideration two factors, time and rate of pay. The standard time for any one job or process may be set by time and motion studies, best worker, average worker, or the average time of all workmen. If daily wage rates of pay are employed, the standard rate is the amount paid per day. When piece rates are used, the standard rate is the amount paid per piece.

Standards for Overhead

When all of the factory overhead expenses have been determined, they are usually distributed on the basis of either labor hours or machine hours. They, however, may be distributed by any of the other methods discussed in the section on overhead accounting; but the two just named are usually the best and most widely used. When distributing factory overhead, the standard is the amount distributed to each job or process determined by a percentage of normal capacity at which the plant operates. In case the plant is not operating at full capacity, only the amount of overhead according to the units produced, or hours, worked, is charged to the cost of manufacturing. Thus a standard for overhead expenses consists not only

of one value but different values for a standard output for factory overhead expenses. Usually variable standards based upon varying rates of output are considered.

When deciding upon variable standards due to varying output, it is necessary to make an analysis of fixed and variable factory overhead expenses. Since the variable expenses increase with the rate of production, the analysis of variable expense is in terms of price, quantity, and rate of production. The fixed overhead expense cannot be controlled, so any variation between the amount charged at the rate at which the plant operates and the amount at the 100% standard capacity is usually considered unavoidable variance, or the activity variation loss.

Variation Analysis

It can be seen that the actual historical costs of operation are not always the same as those which are charged at standard costs. To take care of this difference and to find the causes for the difference, variations from the standards are found and analyzed. The cost accounting department usually does not make the variation analysis. A department under the control of the production manager usually analyzes the variations. Regardless of who analyzes the variations from standard, the procedures are similar and are mainly statistical. Some of the more common causes of variations are:

- (a) Poor quality of material.
- (b) Lack of materials of proper kinds and quantities.
- (c) Poor facilities for the transportation of materials about the plant.

- (d) Poorly trained workmen.
- (e) Dissatisfied workmen.
- (f) Poor working conditions as to heat, light, and ventilation.
- (g) Incorrect instructions.
- (h) Incompetent supervision.
- (i) Incorrect shop and production orders.
- (j) Faulty routing of work through the plant.
- (k) Worn-out machinery.
- (l) Poorly designed, located, or adjusted machinery and equipment.
- (m) Failure of power.
- (n) Lack of sales orders.
- etc., etc.¹¹⁰

Variation losses, if small, need not ordinarily be analyzed further. If the variations are great, further analysis and study will usually help to trace the difficulty and find the responsibility, if any, of the variations. Statistical analysis is objective and shows errors which are recorded in the books. The interpretation of this data must come from the executive, and it may be that even though there are variations they may lie beyond the control of anyone.

The main causes of variations between actual and standard costs are due to variations in price or variations in quantity, or to a combination of both price and quantity. The analysis of variations between material prices and quantity and labor prices and quantity, is similar, but the analysis of variances in overhead usually considers the rate of operation of the business as well as prices and quantity of commodities and services used. To illustrate the method of analyzing price and quantity variance, assume the following conditions:

¹¹⁰Charles F. Schlatter, *op. cit.*, p. 125.

Example I. Variance from Standard quantity of Materials or Labor.

Standard quantity consumed	500 units @ \$.50	\$250.00
Actual quantity consumed	490 units @ .50	<u>245.00</u>
Variance less than standard due to quantity	10 units @ \$.50	<u>\$ 5.00</u>

Example II. Variance from Standard Price of Material or Labor.

Actual Price	500 units @ \$.52	\$260.00
Standard Price	500 units @ .50	<u>250.00</u>
Variance greater than standard due to price	500 units @ .02	<u>\$ 10.00</u>

Example III. Variance from Standard of Price and Quantity of Materials or Labor.

Actual quantity and price	490 units @ \$.52	\$254.80
Standard quantity and price	500 units @ .50	<u>250.00</u>
Variance:		
Quantity Variance	10 units @ \$.50	-5.00
Price Variance	490 units @ .02	<u>+ 9.80</u>
Net Variance		<u>\$ 4.80</u>

Some authorities on analysis of variance have attempted to show the analysis by formulas.¹¹¹ For instance, in the above illustration of Example II, if (A) stands for the actual units consumed at the actual price and (B) is the actual units consumed at the standard price, then (A) - (B) = Variation in price.

¹¹¹For a complete history of Cost and Profit Variation formulas see G. Charter Harrison, Standard Costs, The Ronald Press, New York, 1930, Chapter IV, pp. 49-72. The formulas are also included in L. P. Alford, Cost and Production Handbook, The Ronald Press, New York, 1934, pp. 1196-1202.

(A) = 500 units @ \$.52	\$260.00
(B) = 500 units @ .50	<u>250.00</u>
(A) - (B) = Price Variance	<u>\$ 10.00</u>

Although formulas are often helpful, the following rules are the bases on which the formulas are developed in the case of material and labor.

(a) For determining quantity variance: multiply the number of units above or below standard by the standard cost per unit.

(b) For determining price variance: multiply the actual number of units used by the difference between actual cost and standard cost per unit.

(c) For determining total variance: add the total price and the total quantity variances.¹¹²

The above illustrations include only one item on which a standard has been set. Ordinarily in actual practice, many items are included and the variation between all of the items included is necessary to obtain total variance in price and quantity of material that is included.

A flexible system has been devised to determine the variations from standard of overhead expenses at different levels of operations. It is necessary to know, under this system, the expenses which are fixed and those which are variable. To illustrate the flexible system, suppose a company has a year's normal activity of 12,000

¹¹²See J. F. Sherwood and Franklin T. Chace, Principles of Cost Accounting, Southwestern Publishing Co., Cincinnati, 1942, p. 208.

hours and a normal activity for July, 1943, of 1,000 hours. The actual activity in July is 900 hours. The illustration does not include all expenses which may be a part of the overhead costs of running a manufacturing department, since there are usually service department expenses which are distributed to each department. The procedure is similar, however.

Department A -- Analysis of Factory Overhead Expenses

Expenses	100% Normal (year 12,000 hour)	Normal Month (1,000 hours)	Adjusted to Activity (900 hours)	Actual Ex- penses	Excess Actual over Budgeted
Fixed Overhead Expenses:					
Superintendence	\$2,400.00	\$200.00	\$200.00	\$200.00	
Depreciation of Building	\$ 720.00	60.00	60.00	60.00	
Taxes	<u>120.00</u>	<u>10.00</u>	<u>10.00</u>	<u>10.00</u>	
Total Fixed Expenses	\$3,240.00	\$270.00	\$270.00	\$270.00	
Variable Overhead Expenses:					
Indirect Labor	\$1,200.00	\$100.00	\$ 90.00	\$100.00	\$10.00
Depreciation of Machinery (By Machine hours)	120.00	10.00	9.00	9.00	
Operating Supplies	<u>600.00</u>	<u>50.00</u>	<u>45.00</u>	<u>48.00</u>	<u>3.00</u>
Total Variable Expenses	\$1,920.00	\$160.00	\$144.00	\$157.00	\$13.00
Total Fixed and Variable Expenses	<u>\$5,160.00</u>	<u>\$430.00</u>	<u>\$414.00</u>	<u>\$427.00</u>	<u>\$13.00</u>
Expense Variation Loss					<u>\$13.00</u>

The standard is prepared for a normal year's operation, being fully estimated. It is then adjusted for the rate of each month's operations. By this method, the variations from standard can be isolated and the fault corrected. In the above illustration, the actual expenses of \$427.00 exceed the standard amount at nine-tenths normal capacity (\$414.00 by \$13.00). The loss of \$13.00 comes from items which usually can be controlled and reasons for the loss are usually explained.

If standard costs are operated in conjunction with a job cost system, it is possible to analyze the amount of overhead which has been unabsorbed by charging to the cost of the job, factory overhead at the standard rates. It is necessary to know the standard number of direct labor hours or other application base used in each department together with the actual number of direct labor hours needed and the total factory overhead expense for the department. Since it is usually impossible to tell the rate of operation during the month or at the beginning of the month, the standard rate at a normal capacity is usually charged to each job; then at the end of the month the variation between the normal or 100% rate and the actual rate is determined.

The above example illustrates the variation in expenses which are controllable due to price and quantity. If the normal month is assumed to be 1,000 hours and the total fixed and overhead expenses are \$430.00, the normal application rate would be \$.43 per direct labor hour of activity. Since there were 900 actual direct labor hours, the amount charged to goods in process for factory overhead is:

900 direct labor hours times \$.43 the standard rate = \$387.00

The standard amount for 900 hours operation = \$414.00

The actual expenses of factory overhead = \$427.00

In the factory overhead account, the actual expenses charged during the month are \$427.00. However, the amount of factory overhead charged to the goods in process is only \$387.00, leaving a balance in the Factory Overhead Account of \$40.00. This is made up of an expense variation of \$13.00 and an unavoidable loss due to charging the jobs at a 1,000 hour capacity of \$27.00, computed as follows:

Actual Expenses	\$427.00	
Standard at 900 hours	<u>414.00</u>	
Expense Variation Loss		\$13.00
Standard amount at 900 hours	\$414.00	
Charged to job at 43¢ rate (900 hours x 43¢)	<u>387.00</u>	<u>27.00</u>
Total Variation in Factory Overhead		<u><u>\$40.00</u></u>

Estimating Cost Accounting

In some industries where there is a need of the knowledge of the cost of an article before it is produced, estimating costs are often used. Estimating costs are sometimes called predetermined costs or formula costs, because the cost is estimated or determined before manufacturing operations begin. Such industries as the clothing industry and the construction industry are often called upon to furnish bids or an estimated cost of the work performed

together with the actual cost. Since estimating costs are predetermined costs, they are similar to standard costs; however, being an estimate instead of a scientifically prepared standard, estimating costs are often revised, being used for only one job. Standard costs are for control and are considered the true costs of production, while estimating costs are for simplicity in accounting procedure and for comparison with the actual costs of production. Many of the accounting procedures are similar to standard costs while other procedures are similar to process costs.

Since the books are to be closed at a given period of time, and since the costs are predetermined for that period alone, it is necessary to determine the finished unit equivalent of all work left in process. This is similar to determining finished unit equivalents in process cost accounting. All actual costs are recorded as incurred, but all finished goods and goods sold are charged to the finished goods account and the costs of sales account at the estimated value. Thus the variance in the goods in process account is the variance due to actual costs from the estimated costs. When the variance is known, it is distributed to the goods in process, finished goods, and the costs of sales accounts in proportion to the number of equivalent units which have been finished in each.

Distribution Costs

Within the last decade it has become important to know the costs of selling an article as well as the costs of producing it. Distri-

bution cost accounting attempts to provide an answer to the problem of the cost of selling goods. Fortunately, for the industry which already had a distribution cost accounting system installed, the Robinson-Patman Act of 1937 caused no hardship because of the lack of knowledge of costs, quantity discounts, or other price concessions. The Robinson-Patman Act attempts to prohibit discrimination in price or in terms of sale to purchasers of the same product, such discrimination being price differentials, brokerage or commission payments to dummy concerns, and unfair advertising allowances.

Accounting for distribution costs is similar to factory overhead accounting, under job order costs. Since most of the distribution costs are indirect charges, some method of distributing the charges must be determined. Depending upon what is desired, distribution costs can be determined by units of products, types of customers, (size of sale), or methods of distribution (class of sales). That is, unit costs of selling can be determined for each type of product sold, for each salesman, for each sales office, and for each order sold.

To accurately determine the amount of selling and administrative expenses necessary for each class of analysis, it is necessary to allocate the various expenses to the product, the type of customer, the salesman, or to each sales office. Some of the expenses may be allocated directly to the product, but there are many selling and administrative expenses which must be allocated on some arbitrary basis. The following are some of the most common methods in terms of the major headings:

Distribution of expenses on a product basis

<u>Type of Expense</u>	<u>Distribution Method</u>
Salesmen's Salaries	Time necessary to sell each product weighted on the basis of the sales value of each product.
Advertising, Newspaper	Specific cost on the basis of the number of square inches of space used by each product.
Direct Mail Advertising	Proportionate share of specific cost.
Warehouse Expense, depreciation	On basis of size and average quantity in warehouse. On basis of square feet of warehouse devoted to product.

Distribution of expenses by types of customers

Salesmen's salaries	As a percent of total sales value for each classification of amount of customer sales.
Advertising	
Sales Discounts	Specific amount

Distribution of expenses by sales office

Salesmen's salaries	Time spent in each territory or per cent of sales in each territory, specific expense.
Advertising	Per cent of total sales for each territory. Specific cost.
Sales Office Expense	Specific cost.
Warehouse expense, depreciation	On basis of sales. Specific cost.

No standard basis has yet been adopted for allocating each of the various expenses, however, any reasonable basis may be used.

Usually in distribution cost accounting, it is possible to apply distribution expenses to a certain job, such in the fashion that factory overhead is applied before the actual amount is known. A pre-determined rate of application is decided upon before the period begins, and for every dollar of sales value, a proportionate share of selling and administrative expenses is applied as a cost of selling. Thus, the net profit per sale may be determined whenever a sale is made. The difference between the actual selling and administrative expenses and the applied selling and administrative expenses is usually carried in the Profit and Loss Statement as Other Income or Other Expenses.

Break-even Points

In dealing with costs, it is often desirable to know the point at which it is profitable to continue operations or the point at which it begins to be unprofitable. This point of relationship is often called the break-even point, because it is the point at which sales equals all costs, and any increase in sales usually results in an increased profit while any decrease in sales results in an increasing loss. In the computation of the break-even point it is necessary to know all of the fixed costs, all of the variable costs, and the income from sales at the maximum output. The formula to compute the break-even point is:

$$B = \frac{F}{1 - \frac{V}{S}}$$

B = Sales at the break-even point

F = Fixed costs at maximum output

V = Variable costs at maximum output

S = Sales value of maximum output

To illustrate the computation of the break-even point, suppose a company has fixed costs of \$100,000. Variable costs of \$250,000 and the sales value of the maximum goods produced are \$500,000. The break-even point is determined as follows:

$$B = \frac{F}{1 - \frac{V}{S}}$$

$$B = \frac{\$100,000}{1 - \frac{\$250,000}{\$500,000}}$$

$$B = \frac{100,000}{1 - \frac{1}{2}}$$

$$B = \$200,000$$

Chart X illustrates the computation of the break-even point by means of a graph. Whenever the costs are computed, all expenses are taken into consideration. Not only the costs of production are considered, but also the costs of selling and administering the business. In the chart, the fixed costs are added to the variable costs to obtain the total costs. Any output below the B point shows a loss, while any output above the B point shows a profit.

In the determining the break-even point, it is necessary to know the fixed and variable expenses. Many times it is possible to analyze the expenses of production into fixed and variable items; however, the analysis is not as easy as it may seem. It is often said that there is no item which is absolutely fixed, and all expenses are at times variable. Thus, in the general analysis of fixed

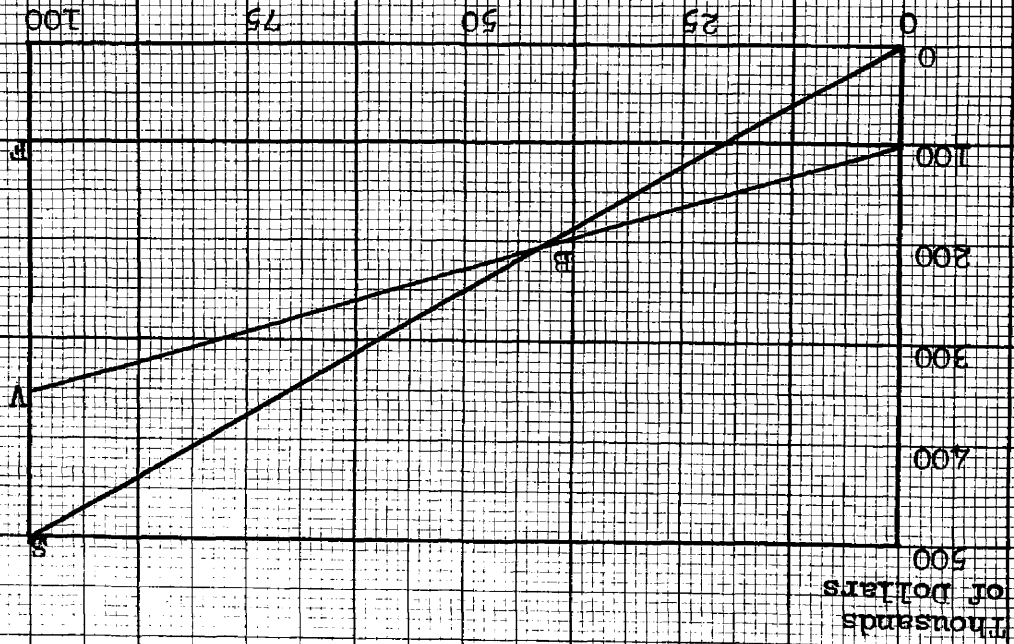


Chart X. Break-even Chart.

and variable content of expense items, the items which are relatively constant may be considered fixed, while those which vary in direct proportion to the output are considered variable. It is also possible to analyze the fixed and variable proportion of expense items through correlation when the expenses vary in proportion to the output. The following illustration shows the methods of analyzing the fixed and variable content of expenses by correlation. Assume that the Jones Manufacturing Company has the following operating conditions:

Jones Manufacturing Company

<u>Month</u>	<u>Output (000)</u>	<u>Expense (000 dollars)</u>
January	1.0	12
February	1.5	20
March	2.0	27
April	3.5	40
May	4.0	45
June	5.0	50

If the output is the independent variable and the expense is the dependent variable, to find each amount of fixed and variable expenses, the normal equations $\sum Y = na + b\sum X$ and $\sum XY = a\sum X + b\sum X^2$

When:

a = the fixed expense

b = the amount of variable expenses added for each increase in output

X = the output per month

Y = the expense in dollars

Jones Manufacturing Company

<u>Month</u>	<u>Output (X)</u>	<u>Expenses Y</u>	<u>X²</u>	<u>XY</u>
Jan.	1.0	12	1.00	12.0
Feb.	1.5	20	2.25	30.0
Mar.	2.0	27	4.00	54.0
April	3.5	40	12.25	140.0
May	4.0	45	16.00	180.0
June	<u>5.0</u>	<u>50</u>	<u>25.00</u>	<u>250.0</u>
	17.0	194	60.50	666.0

By substitution in the normal equations the following is obtained:

$$194 = 6a + 17b$$

and

$$666 = 17a + 60.5b$$

Solving the equations, "a" is found to equal 3.506 and "b" to equal 9.432. The "a" factor shows that the fixed expenses of \$3,506 are necessary for any amount produced. The variable expenses "b" shows that \$9,432 is added to the fixed expenses for each additional thousand units produced. These figures show the average amounts which are fixed and variable and with the least squares equation $\bar{Y}_c = a + b\bar{X}$ the total average expenses can be determined at any stage of output. For example, if the average total expenses for 1000 units is desired, the fixed expenses of \$3,506 added to the variable expenses of \$9,432 give a total average expense of \$12,936 as compared to the actual expenses of \$12,000.

Differential Costs

On somewhat the same general principle as break-even points, differential costs attempt to show the profit or loss at varying rates of output. Whereas the break-even point shows the point of output at which the profit or loss is at zero, differential costs expands the problem of how much profit can be made if the output is increased ten per cent, twenty per cent, or if the output remains constant. Thus, differential costs are forecasted costs, and when compared with the selling price, can be used as an aid in budgeting or forecasting.

Differential costs are total costs; not only the costs of manufacturing but the costs of selling and administration. If all of the costs varied in proportion to the output, the selling price alone would determine the amount of profit made. However, not all costs vary in proportion to production. Many costs are relatively fixed and remain so unless production demands that the plant be increased in size. Many of the fixed costs are only relatively fixed, and often the variable costs do not vary in proportion with production. The problem of determining the costs of production at varying outputs would then be to determine the fixed and variable expenses at each of the levels of output. Usually for convenience the fixed expenses are considered absolutely fixed at any level of output and the variable expenses are then added to find the total costs of production at any amount of output. The method of determining fixed and variable items by correlation, as given in the discussion of

break-even points, is sufficient when the variable items vary in proportion to production and the fixed items remain constant throughout all levels of production. The line of fit would have to be extended into production that is not available in the data from which the line was determined. If the total cost line is not a straight line then, after plotting on a chart, the mathematical process which fits the line may be used. If the line is concave upward, logarithms of the actual price may be used instead of the real price. Likewise, reciprocals of the actual price may also be used in computing the estimating equation instead of the real price, when the curve is concave upward. When the curves increase at an increasing rate or decrease at a decreasing rate, second degree curves may be fitted. Such curves have three constants rather than the two in a straight line.¹¹³

After the fixed and variable costs have been determined for any output, it is necessary to know the sales price at each level of output. Ordinarily, under competitive conditions, the sales price per unit is the same for all levels of output. However, under some conditions, increased output means that to get rid of the output, a decreased sales price is necessary. Theoretical economics has attempted to answer the question of the appropriate level of output by saying that where the marginal revenue curve cuts across the marginal cost curve is the place of best output for maximum profits.

¹¹³For methods of computing non-linear trend lines see Frederick A. Coxtan and Dudley J. Cowden, op. cit., pp. 691-738.

Total costs would have to be reduced to a unit cost for each level of output, and the selling price would be the unit price for each level of output. "Marginal cost is the addition to total cost made necessary by producing the last additional unit at each output,"¹¹⁴ whereas "marginal revenue is the net amount added to total revenue by each successive unit that is added to the number offered for sale."¹¹⁵

Differential costs are not entered in the accounting records but are used as a guide for budgeting, and in case of overproduction or underproduction. Past accounting records are used to obtain the information from which the differential costs are determined and whereas the past does not always signify what is going to happen in the future, it is helpful in guiding future conduct.

Cost Statements and Reports

Cost accounting has the same financial balance sheet and profit and loss statement as financial accounting. In addition to the regular financial reports, cost accounting demands that operating and cost reports be made for the use of department heads and general executives.

The reports which are made vary with the plant; but any plant with a budget or standard costs should prepare statements to show the

¹¹⁴Albert L. Meyers, Elements of Modern Economics, Prentice-Hall, Inc., New York, 1937, p. 106.

¹¹⁵Ibid., p. 54.

executive in charge of each department the comparisons between the standard amount and the budgeted amount of direct labor, materials, and overhead.

The production records of employees should be submitted to the foreman in charge of the employees. If comparisons are made between different departments, it is possible to compare performances under different foremen.

Scrap, spoilage and defective material reports may show operating heads where it is possible to stop many leaks and correct losses from this angle. Reports on the times that machines are idle and the reasons for the idleness may help to minimize losses from that cause. The "repairs to machines report" shows which machines cost the most to operate and the comparative figures of other machines. It is also possible to have daily reports of different departments with a comparison to a standard.

All of these reports are statistical, and to illustrate the facts which are found in them so as to visualize them immediately, charts are often used. Since amounts are used with the values in cost accounting, it is possible to show not only comparisons of values but also comparisons of amounts. In addition to the charts described in a preceding chapter, special type charts for production and control are used in cost accounting. The Z chart, an invention patented by Willard C. Brinton, shows production and values by months, cumulative months, and moving annual totals for seasonal changes. It not only has graphic lines which are easy to follow,

but also has the actual figures. The Gantt chart is used to a great extent to measure performance against a standard schedule. By the use of spaces representing time and different bars representing amounts, it is possible to know whether the scheduled and actual production are in line.

Probably the easiest method of observing the relationship between two cost items is to plot both on one graph, using comparable scales, and to observe if both lines go up and down together. Another graphic method is the scatter diagram. The two series are arranged in sequence. By letting the X axis equal the independent variable and the Y axis the dependent variable, it is possible to plot the points where the two meet. When the points fall in a line, there is correlation to the degree that the points fall in a straight line. Either linear or curved linear lines may be observed from the scatter diagram.

Cost charts may show the different types of costs which a company incurs. Constant, variable, and total costs may be compared for different businesses and for different periods of time. Break-even charts are used to show the point at which profit begins to be made. Break-even charts can be used for production amounts or for probable expansion. The possibility also exists of showing various elements of cost for each unit produced at different capacities and to compute total cost and profit at varying capacities. With a semi-logarithmic chart each of the lines on the same chart when the rates of change of material, labor, and overhead are being compared may be shown.

CHAPTER XIV

MISCELLANEOUS USES OF STATISTICAL METHODS BY ACCOUNTANTS

THE UNIFORM COST ACCOUNTING

The Development of Uniform Accounting

The statement is often made that one manufacturer has no trouble in competition with another manufacturer when both have a knowledge of costs of producing and distributing their goods. Only those who do not know the costs of production and distribution sell below those costs. It is possible for different operators to have the same material costs, the same labor costs, and the same overhead costs, yet through different methods of application of overhead show the same types of products costing different amounts. If they sell their goods in relation to their cost price, the manufacturer who distributes less overhead to one product sells that product at the lowest price. The same is true of all of the other manufacturers, i.e., they sell particular goods at the lowest price only when they distribute overhead to such goods at the lowest ratio. Each of them sells more of the goods which make the least profit, yet none of them is making enough to carry on the business.

Competition is the lifeblood of American trade, but when

competition is "cut-throat" and manufacturers and distributors have no knowledge of costs of production and of operating conditions, in the long run no one, including society, benefits. The development of uniform accounting systems did not have as its object the elimination of competition among manufacturers. In fact, the manufacturer who can manufacture goods at the lowest cost still has the advantage over the high cost producer; yet both know how they stand in relation to each other and can, if possible, wisely provide for any actual cost differences between themselves.

Uniform cost accounting for various industries has been in use generally only since the beginning of the present century. The United States government, through the Interstate Commerce Commission and the Federal Trade Commission, has been instrumental in developing uniform cost methods, but the various trade associations have been instrumental in the major applications of this developmental work.

During World War I, when cost plus contracts were in force, there existed a need for uniformity in the definition of costs. During the depression of the "thirties" the government encouraged the development of uniform methods of accounting by trade associations and during the W.I.R.A. period, some uniformity was demanded in accounting methods. The Department of Manufactures of the Chamber of Commerce of the United States has done most to encourage various trade associations to achieve uniformity in accounting methods. Today nearly half of the trade associations in the United

States have some type of uniform accounting methods. About 30% of the members of the association having uniform systems have adopted the system pertaining to their association, but these firms do about 80% of the business in their fields.¹¹⁶

The Principles of Uniform Accounting Systems

Almost every individual concern in the country is confronted with problems which are pertinent to that one firm only. To develop any type of accounting system which would be absolutely uniform for all firms would be impossible. It is not the purpose of the trade associations which have developed these uniform systems to require uniformity to such an extent that there can be no flexibility in the system. The main object of uniform cost systems is to make the members cost conscious and to have enough uniformity for statistical comparisons.

Usually a uniform accounting system involves a uniform classification of accounts, so that every member who employs the system calls the same accounts by the same name. Uniform methods of valuing inventories and charging freight-in and handling charges to the inventories are applied. Different forms of labor are broken down so that each member knows what is direct labor and what is indirect labor. The expense categories which make up overhead are planned to be the same for all using the system, even though some members may not use every one of the various classifications.

¹¹⁶John J. Neuner, op. cit., p. 671.

Depreciation rates and interest rates are determined so that each member charges typical amounts for the appropriate expense. Methods of distribution of overhead are the same for all. Those expenses which go to the selling and administrative departments are classified so that each member allocates them the same way.

Forms of cost records, statements, and reports are designed so that it is possible to report uniformly. Methods of setting up and operating the system are explained to the members, so that they can conduct the procedures correctly. Some trade associations employ an accountant who travels to the different members to help them set up the system and keep it in operating condition.

The members report on standard forms the results of their operations for the period, and in return receive statistics of the entire group for comparison. At times the members report actual figures, at other times only ratios and percentages.

Statistical Uses of Trade Association Accounting

The Trade Association Department of the Chamber of Commerce of the United States publishes a booklet written by the manager, Philip F. Gott. This booklet develops the uses of trade association statistics in manufacturing. It breaks the statistics down under three separate headings, (1) production and sales statistics, (2) cost statistics, and (3) price statistics. It provides outlines for each of the different headings which adequately summarize the use of Trade Association statistics for manufacturing concerns. The following outline summarizes application of statistics of production and sales:

Application of Production and Sales Statistics:

- (1) Show the relative position of each industry to all industry;
- (2) Enable each concern to ascertain its relative position to the industry as a whole;
- (3) Aid the individual concern in stabilizing and scheduling its production at the most profitable level by indicating changing situations with respect to orders, production, shipments, and stocks, thus avoiding the pitfalls of excessive or depleted stocks;
- (4) Aid the industry in stabilizing employment;
- (5) Aid the industry in stabilizing earnings;
- (6) Indicate trends in the utilization of capacity, which in some industries are forecasters of price increases or price declines;
- (7) Enable management, in formulating business policies, to utilize information concerning industries from which they buy, to which they sell, and with which they are directly competitive;
- (8) Identify centers of demand and purchasing power, when broken down by regions, thus promoting economical distribution.¹¹⁷

Production and sales involve many other considerations which affect the plant. Inventories, capacity, labor, and overhead all must be considered under these headings. Given statistics for the individual company and for the trade association, it is possible to compare trends as to production, sales, and ratios of each, and to indicate the relative position of the company as related to the industry as a whole. Trends in the amount of inventory, percentage of inventory to sales, and the percentage of capacity of the company as related to association data can be computed.

When sales are analyzed as to type of customer, type of commodity, and geographical location of customer, customer centers of demand

¹¹⁷ Chamber of Commerce of the United States, Use of Trade Association Statistics in Manufacturing, Washington, D.C., 1937, p. 3.

and the centers of purchasing power are ascertained. The following summary shows how cost statistics are used:

Applications of Cost Statistics

- (1) Provide efficiency "yardsticks" for the industry against which the operations of the individual concern may be compared;
- (2) Bring changing cost conditions to the attention of management in order that appropriate modifications in business policies may be made;
- (3) Aid executives in appraising conditions of demand and supply in industries from which raw materials and supplies are purchased, for the purpose of making these purchases at the most advantageous prices possible;
- (4) Reveal relative strength or weakness of the credit and collection policies of the individual concern and its relative cost of carrying outstanding accounts;
- (5) Serve as a guide in detailed studies of labor efficiency and labor costs within the concern;
- (6) Bring to light inefficiencies and wastefulness of particular operations and departments;
- (7) Assist management in its efforts to reduce the percentage of gross profits absorbed by distribution costs.¹¹⁸

"Trade association cost statistics include industry studies of general costs of production and of doing business; cost conditions of the industry; costs of raw materials and supplies; costs of credit; costs of particular operations and departments; costs of labor; costs of selling and other distributive functions."¹¹⁹

These cost statistics provide a "yardstick" whereby the individual concern measures its various costs as compared with those of the industry as a whole. All of the above costs and trends of costs

¹¹⁸Ibid., p. 17.

¹¹⁹Ibid., p. 18.

are provided for comparison with each other. For an analysis of price statistics, the following outline is given:

Application of Price Statistics:

- (1) Are used by management in appraising general business conditions;
- (2) Reveal the relationship of prices of the industry with the general price level, bringing to light trends in the purchasing power of the salesdollar;
- (3) Disclose competitive advantage or disadvantage arising from changes in the relationship of the prices of substitute commodities;
- (4) Provide a means whereby management is able to estimate whether the price policy of the individual concern gives it a competitive advantage over other units in the industry;
- (5) Aid management in determining the price to be placed on specific articles, and whether existing differentials should be raising or lowered;
- (6) Are used in conjunction with production and sales figures in arriving at production policies, thus assisting in budgeting purchases of materials and accumulation or depletion of stocks and inventories;
- (7) Are of value, when used with sales estimates and "cost yardsticks," in setting up a budget of expenditures;
- (8) Identify most profitable lines or price ranges in which to concentrate;
- (9) Aid management in forecasting profits or losses.¹²⁰

Information in the form of price indices, open prices, averages and quoted prices, and price studies are valuable in all of the above categories. Information is sometimes furnished about competitive industries as well as for the individual industry for comparative purposes.

The above summaries of uses of trade association statistics relate particularly to manufacturing concerns. Nevertheless, these methods are applicable to all types of firms--manufacturing, trading, or service.

¹²⁰Ibid., p. 18.

Index Number Accounting

Index number accounting, commonly called "Stabilized Accounting," originated in Germany after the first World War as a result of the fluctuations in value of the German monetary unit. Since that time it has been developed to a higher degree by an American, H. W. Sweeney. Numerous articles have been written on the advantages and disadvantages of this accounting method, but the entire procedure is at present theoretical. No attempt will be made to show any of the advantages and disadvantages, but only to show how accounting may be employed in connection with statistics to secure stabilized accounting.

Stabilized accounting is used to correct changes in value which result from variations in the purchasing power of the dollar. The method of measuring these changes is by means of a price level index, which shows the present purchasing power of the dollar in relation to its purchasing power some other period.

Using this index, it is possible to determine the cost of any article to be reproduced or replaced over any time period for which there is available an index number of prices.

"Stabilized Accounting" takes into consideration the different assets whose face amounts are expressed in definite monetary units; therefore no change in amounts can take place with the changes in the price level. These assets, such as cash and accounts receivable, are expressed in definite amounts which always remain the same.

Sweeney calls them "money value assets."¹²¹ Another type of assets, called "real-value assets," are those assets whose value may change with varying price levels, since there are no definite specified "face amounts." Inventories, land, and buildings are examples of such assets.

There are two methods of stabilization, viz., (a) stabilizing each entry and (b) stabilizing the balance sheet. Under the method of stabilizing each entry, whenever a "money-value" item is entered on the books, an adjustment is made for any changes which are the result of varying price levels. This adjustment is made by use of index numbers. For example, if there is a \$2,200 cash credit arrived at when the general index was 110, the equivalent cash at an index of 100 is \$2,000. If the cash balance was arrived at when the index was 200, the equivalent cash is $\frac{200}{100} \times \$2,200$, or \$4,400. Each entry is adjusted and the real value items are adjusted, by means of the price index, at the end of the period to give a final balance.

Stabilization of the balance sheet is accomplished by adjusting the "real value" items by means of the price level index. An unrealized gain or loss results. This realized gain or loss is found by adjusting the "money-value" items. When adjusted, the balance sheet shows the amounts of assets in terms of relative purchasing power instead of mere "money amounts."

"Stabilized Accounting" is mentioned, not because of its merits or disadvantages, but because it shows how statistics and accounting may be used together to produce a new method of handling accounting items.

¹²¹Henry W. Sweeney, Stabilized Accounting, Harper & Brothers Publishers, New York, 1936, p. 11.

SELECTED BIBLIOGRAPHY

Books

- Alford, L. P., Editor. Cost and Production Handbook. The Ronald Press. New York. 1934. 1544pp.
- _____, Editor. Managements Handbook. The Ronald Press. New York. 1924. 1607pp.
- American Institute of Accountants. Examination of Financial Statements by Independent Public Accountants. A Bulletin prepared and published by the American Institute of Accounts. Jan. 1936. 41pp.
- _____, Experiences with Extension of Auditing Procedure and Papers on Other Accounting Subjects. Presented at the Fifty-third annual meeting American Institute of Accountants. New York. 1940. 269pp.
- _____, Papers on Auditing Procedure and Other Accounting Subjects. 1939. Presented at the fifty second annual meeting of the American Institute of Accountants. New York. 295pp.
- American Institute of Banking. Analyzing Financial Statements. New York. 1939. 480 pp.
- American Marketing Association. The Technique of Marketing Research. McGraw-Hill Book Company, Inc. New York. 1937. 432pp.
- Arkin, Herbert and Colton, Raymond R. Graphs How to Make and Use Them. Harper & Brothers Publishers. New York. 1940. 236pp.
- Bliss, James H. Financial and Operating Ratios in Management. The Ronald Press. New York. 1932. 396pp.
- _____, Management Through Accounts. The Ronald Press Company. New York. 1924. 851pp.
- Blocker, John G. Cost Accounting. McGraw-Hill Book Company, Inc. New York. 1940. 805pp.

- Boddington, A. Lester. Statistics and their application to Commerce. Sir Isaac Pitman & Sons, Ltd. London. 1941. 360pp.
- Brown, Lyndon O. Market Research and Analysis. The Ronald Press Company. New York. 1937. 485pp.
- Brown, Theodore H. The Use of Statistical Technique in Certain Problems of Market Research. The Harvard University Bureau of Business Research. Boston, Mass. May 1935. 24pp.
- Brumbaugh, Martin A. and Kellog, Lester S. Business Statistics. Richard D. Irwin, Inc. Chicago. 1942. 913pp.
- Canman, E. A. Basic Standard Costs. American Institute Publishing Co. New York. 1932. 486pp.
- Carmichael, Geoffrey. Accounting Principles and Procedures. Longmans Green, and Co. New York. 1936.
- Gary, C. R. and others. Product-Line Profit and Loss Statements. American Management Association. New York. 1941. 44pp.
- Chaddock, Robert Emmet. Principles and Methods of Statistics. Houghton Mifflin Company. Boston. 1935. 471pp.
- Chamber of Commerce of the United States. Cost Accounting Through the Use of Standards. 1933. Washington, D. C.
- _____, Perpetual Inventory and Stores Control. Washington, D.C.
- _____, Trade Association Statistics and the Administration of Codes. Washington, D. C.
- _____, Use of Trade Association Statistics in Manufacturing. 1937. Washington, D. C.
- Chatters, Carl H. and Tenner, Irving. Municipal and Governmental Accounting. Prentice-Hall, Inc. New York. 1940. 794pp.
- Church, Donald E. Speed Methods of Statistics. The Ronald Press Company. New York. 1940. 97pp.
- Cole, William Morse. Accounts, Their Construction and Interpretation. Houghton, Mifflin Company. Boston. 1915. 444pp.
- Committee on Statistical Reporting and Uniform Accounting for Industry of the business Advisory and Planning Council for the Department of Commerce. Reports to Stockholders. U. S. Government Printing Office. Washington. 1934.

- Connor, L. R. Statistics in Theory and Practice. Sir Isaac Pitman & Sons, Ltd. London. 1938. 383pp.
- Groxton, Frederick L. and Cowden, Dudley J. Applied General Statistics. Prentice-Hall, Inc. 1939. New York. 924pp.
- Crum, William Leonard and Patton, Alison Currie. An Introduction to Economic Statistics. A. W. Shaw Company. Chicago. 1924. 493pp.
- Patton, Alison Currie and Tebbut, Arthur Rothwell. Introduction to Economic Statistics. McGraw-Hill Book Company, Inc. New York. 1938. 423pp.
- Curtis, A. B. and Cooper, J. M. Mathematics of Accounting. Revised Edition. Prentice-Hall, Inc. New York. 1940. 480pp.
- Davenport, Donald H. and Scott, Frances V. An Index to Business Indexes. Business Publications, Inc. Chicago. 1937. 187pp.
- Davies, George R. and Yoder, Dale. Business Statistics. John Wiley & Sons, Inc. New York. 1937. 548pp.
- Davis, Albion; Staub, Walter A., and Patterson, George A. New Accounting Techniques for War Conditions. American Management Association. New York. 1942. 31pp.
- Davis, Harold T. The Analysis of Economic Time Series. The Principia Press, Inc. Bloomington, Indiana. 1941. 620pp.
- Day, Edmund L. Statistical Analysis. The Macmillan Co. New York. 1930. 495pp.
- Dewey, Homer E., Director. "The A.I.L. Revised System of Uniform Accounting." American Institute of Laundering. Service Bulletin No. 30. Joliet, Ill. 1934.
- Dohr, James L., Ingraham, Howell A., and Love, Andrew L. Cost Accounting Principles and Practice. The Ronald Press. New York. 1935. 621pp.
- Donald, W. J., editor. Handbook of Business Administration. McGraw-Hill Book Company, Inc. New York. 1931. 1753pp.
- Ezekiel, Mordecai. Methods of Correlation Analysis. Second Edition. John Wiley and Sons, Inc. New York. 1941. 531pp.
- Eastwood, R. Parker. Sales Control by Quantitative Methods. Columbia University Press. New York. 1940. 311pp.

Encyclopedia of the Social Sciences. "Statistics." The Macmillan Company. New York. 1937.

Finney, H. A. Principles of Accounting. Vol. I. Prentice Hall, Inc. New York. 1936. 30 Chapters.

_____, Principles of Accounting. Vol. II. Advanced. Prentice Hall, Inc. New York. 193_. 30 Chapters.

Fisher, R. A. Statistical Methods for Research Workers. Oliver and Boyd. Edinburgh. 1928. ____pp.

Field, E. I. Balance Sheet Classification and Terminology. New York. 1936. 218pp.

Folts, F. E. and Stillman, A. E. Interpretive Accounting. Longmans, Green and Co. New York. 1930. 432pp.

Foulke, Roy A. Behind the Scenes of Business. Revised Edition. Dun and Bradstreet, Inc. New York. 1937. 221pp.

Freeman, H. A. Industrial Statistics. John Wiley & Sons, Inc. New York. 1942. 178pp.

Gardiner, Fred V. Variable Budget Control. McGraw-Hill Book Co. Inc. New York. 1940. 357pp.

Gavett, G. Irving. Statistical Method. McGraw-Hill Book Company, Inc. New York. 1923. 358pp.

Gilman, Stephen. Analyzing Financial Statements. Revised Edition. The Ronald Press Co. New York. 1934. 475pp.

_____, Accounting Concepts of Profit. The Ronald Press Co. New York. 1939. 635pp.

Glover, John G. and Maze, Coleman L. Managerial Control. The Ronald Press. New York. 1937. 594pp.

Graham, Benjamin and Dodd, David L. Security Analysis. Second Edition. McGraw-Hill Book Company, Inc. New York. 1940. ____pp.

Graham, Jennie Scott. Arithmetic Review for Retail Training Groups. School of Retailing. New York University. New York. 30pp.

Grant, Harris D. Simplified Mathematics for Accountants and Executives. McGraw-Hill Book Company, Inc. New York. 1931. 329pp.

Greendlinger, Leo. Financial and business Statements. Alexander Hamilton Institute. New York. 1917. 32pp.

- Gregory, Homer L. Accounting Reports in Business Management. The Ronald Press Company. New York. 1928. 445pp.
- Guthmann, Harry G. The Analysis of Financial Statements. Revised Edition. Prentice Hall, Inc. New York. 1930. 584pp.
- Harrison, G. Charter. Standard Costs. The Ronald Press Co. New York. 1930. 308pp.
- Hayes, Howard V. Accounting for Executive Control. Harper & Brothers Publishers. New York. 1929. 495pp.
- Heckert, J. Brooks. Accounting Systems. The Ronald Press Company. New York. 1936. 514pp.
- Hilbert, Joseph Robert. Cost Accounting for Sales. The Ronald Press Company. New York. 1926. 259pp.
- Holman, Leonard J. Compiled Statistics. Sir Isaac Pitman & Sons, Ltd. London. 1938. 172pp.
- Kilduff, Frederic W. Auditing and Accounting Handbook. McGraw-Hill Book Company, Inc. New York. 1927. 813pp.
- Knobbel, C. E. and Seybold, Edgar G. Measuring for Profits. McGraw-Hill Book Company, Inc. New York. 1937. 343pp.
- Koren, John. The History of Statistics. The Macmillan Co. New York. 1918.
- Kraft, Carl and Starkweather, Louis F. Analysis of Industrial Accidents. The Ronald Press Company. New York. 1930. 307pp.
- Kurtz, Albert W. and Ridgerton, Harold A. Statistical Dictionary of Terms and Symbols.
- Kurtz, Edwin B. Valuation and Depreciation. The Ronald Press Company. New York. 1937. 221pp.
- LaSalle Extension University. Cost Accounting Procedure. Chicago. 1937. 359pp.
- Littleton, A. C. Accounting Evolution to 1900. American Institute Publishing Co., Inc. New York. 1933. 373pp.
- Macdonald, John H. Practical Budget Procedures. Prentice-Hall, New York. 1940. 326pp.
- Malin, Frank Bradshaw. Overhead Costs in Theory and Practice. London. 1936.

- Manning, Anthony B. Elements of Cost Accounting. McGraw-Hill Book Co., Inc. New York. 1924.
- Maze, Coleman L. and Glover, John G. How to Analyze Costs. The Ronald Press Co. New York. 1929. 389pp.
- McKinsey, James O. Budgetary Control. The Ronald Press Co. New York. 1922. 474pp.
- Mayers, Albert L. Elements of Modern Economics. Prentice-Hall, Inc. New York. 1937. 363pp.
- Miller, Isaiah Leslie. Business Mathematics. D. Van Nostrand Company, Inc. New York. 1935. 376pp.
- Mills, Frederick Cecil. Statistical Methods. Revised. Henry Holt and Company. New York. 1938. 746pp.
- Montgomery, Robert H. Auditing Theory and Practice. Sixth Edition. The Ronald Press Company. New York. 1940. 692pp.
- Mudgett, Bruce D. Statistical Tables and Graphs. Houghton Mifflin Company. Boston. 1930. 194pp.
- National Association of Cost Accountants. The Control and Valuation of Inventories. National Association of Cost accountants. New York. 1941. 406pp.
- Neuner, John J. W. Cost Accounting Principles and Practices. Business Publications, Inc. Chicago. 1938. 710pp.
- Nicholson, J. Lee and Rohrbach, John F. D. Cost accounting. The Ronald Press Co. New York. 1919. 576pp.
- Noble, Howard S., Karrenbrock, Wilbert L., and Simons, Harry. Advanced Accounting. Southwestern Publishing Company. Cincinnati. 1941. 846pp.
- Owens, Richard Norman and Kennedy, Ralph Dale. Accounting, Elementary Theory and Practice. D. Van Nostrand Company, Inc. New York. 1938. 687pp.
- Paton, W. A., editor, Accountant's Handbook. The Ronald Press. New York. 1934. 1873pp.
- _____, Accounting Theory. The Ronald Press. New York. 1922. 508pp.

Paton, W. A. and Littleton, A. C. An Introduction to Corporate Accounting Standards. American Accounting Association. Chicago, Ill. 1940. 156pp.

Peters, Charles C. and Van Voorhis, Walter R. Statistical Procedures and their Mathematical Bases. McGraw-Hill Book Company, Inc. New York. 1940. 516pp.

Rautenstrauch, Walter. The Design of Manufacturing Enterprises. Pitman Publishing Corporation. New York. 1941. 298pp.

_____, The Economics of Business Enterprises. John Wiley & Sons, Inc. New York. 1939. 445pp.

Reitell, Charles and others. The Presentation of Costs for Executives. National Association of Cost Accountants. New York. 1928. 285pp.

Riggleman, John R. and Frisbee, Ira N. Business Statistics. McGraw-Hill Book Company, Inc. New York. 1938. 790pp.

Rorem, C. Rufus. Accounting Method. The University of Chicago Press. Chicago. 1928. 596pp.

Rowland, Floyd H. How to Budget for Profit. Harper and Brothers Publishers. New York. 1933. 297pp.

Sellers, Earl A., Editor. Accountants' Handbook. The Ronald Press Company. New York. 1923. 1596pp.

_____, Depreciation Principles and Applications. Third Edition. The Ronald Press Company. New York. 1939. 482pp.

Schlatter, Charles F. Elementary Cost Accounting. John Wiley and Sons, Inc. New York. 1939. 321pp.

_____, Advanced Cost Accounting. John Wiley and Sons, Inc. New York. 1939. 217pp.

Schlauch, William S. and Lang, Theodore. Mathematics of Business and Finance. The Ronald Press Company. New York. 1937. 548pp.

Secrist, Horace. An Introduction to Statistical Methods. The Macmillan Company. New York. 1917. 482pp.

Selva, James P. and Lee, Morris M. Making the Annual Report Speak for Industry. Compiled by the National Association of Manufacturers. McGraw-Hill Book Company, Inc. New York. 1938. 187pp.

Sherwood, J.F. and Chace, Franklin T. Principles of Cost Accounting. Southwestern Publishing Company. Cincinnati. 1942. 271pp.

- Shewhart, Walter A. and Deming, W. Edwards. Statistical Method from the Viewpoint of Quality Control. The Department of Agriculture. Washington. 1939. 155pp.
- Speethrie, Samuel Waldo. Mathematics for the Accountant. The Ronald Press Company. New York. 1940. 209pp.
- Stockton, John R. An Introduction to Business Statistics. D. C. Heath and Co. Boston. 1938. 378pp.
- Sweeney, Henry W. Stabilized Accounting. Harper and Brothers. New York. 1936. 219pp.
- Thompson, William Rodney. Accounting Systems, Their Design and Installation. La Salle Extension University. Chicago. 1939.
- Tugwell, Rexford Guy, Editor. The Trend of Economics. Alfred A. Knopf. New York. 1924. 556pp.
- Van Sickle, Clarence L. Cost Accounting. Harper & Brothers. New York. 1938. 998pp.
- Van Tuyl, George H. Mathematics of Business. American Book Company. New York. 1940. 502pp.
- von Mises, Richard. Probability, Statistics and Truth. William Hodge and Co., Ltd. London. 1939. 323pp.
- Wagner, Charles G. and others. Introduction to Statistics. The Pennsylvania State College. 1941. 123pp.
- Wall, Alexander. How to Evaluate Financial Statements. Harper and Brothers. New York. 1936. 319pp.
- _____, The Banker's Credit Manual. Merrill Company. Indianapolis. 1924. 324pp.
- _____, and Dunning, Raymond W. Ratio Analysis of Financial Statements. Harper and Brothers. New York. 1928.
- Walton, Seymour and Finney, H. A. Mathematics of Accounting and Finance. The Ronald Press Company. New York. 1921. 274pp.
- Wingate, John W. and Brisco, Morris A. Elements of Retail Merchandising. Prentice-Hall, Inc. New York. 1938. 475pp.
- Yule, G. Unsey. An Introduction to the Theory of Statistics. Charles Griffin and Company, Limited. London. 1929. 424pp.

Yule, G. Udney and Kendall, M. G. Theory of Statistics. Charles Griffin and Company, Limited. London. 1940. 570pp.

Young, Benjamin Franklin. Statistics as Applied in Business. The Ronald Press Co. New York. 1925. 639pp.

Periodicals

Ashley, Sir William. "Sir William Petty and the Beginnings of Statistics." Accountant. May 28, 1921. pp. 692-694.

Adamson, A. A. "General Methods and Use of Statistical Aids in Analysis and Interpretation of Accounting Statements." Accountant. July 18 and July 25, 1936. p. 98 and 130.

Andrew, Seymour L. "Relation of Statistics to accounting in Business Organizations." L. R. B. & M. Journal. March 1928. p. 1.

Back, W. J. "Statistical Presentation of Financial Data." Accountant. Sept. 14, 1935. pp. 373-9.

Bernard, Rene J. "How We Plan, Set Up and Operate Our Budget." N.A.A.C.A. Bulletin. New York. Feb. 1, 1936. p. 576-604.

Bliss, Charles A. "Statistics Takes a Second Breath." Harvard Business Review. Vol. XVIII. No. 4. Summer 1940. p. 510.

Blocker, John G. "Budgeting in Relation to Standard Costs." Accounting Review. June 1936. p. 117-24.

Boateright, John W. "Principles and Procedures for Putting Across Business Statistic Reports to Executives." Journal of American Statistical Association. Vol. 36. p. 219-224.

Burgess, R. C. "Statistical Interpretation of Accounts." The Accountants Digest. Dec. 1935. p. 208.

Carman, Lewis A. "The Efficacy of Tests-Rest-Checking subjected to Mathematical Analysis." The American Accountant. Dec. 2, 1933. pp. 360-366.

Carroll, Gay. "The Group System of Depreciation." N.A.A.C.A. Bulletin National Association of Cost Accountants. December 15, 1941. pp. 473-497.

Castenholz, W. B. "Why not 'Attrition'." The Journal of Accountancy. Vol. 74. pp. 341-349.

- Coleman, L. W., Jr. "The Use of Determinants in the Solution of Linear Equations." The Accounting Review. Jan. 1943. pp. 44-48.
- de Roover, Raymond. "Characteristics of Bookkeeping before Paciclo." The Accounting Review. June 1938. pp. 144-49.
- Freeman, L. Stewart. "Cost Analysis a Science, but Pricing May be Classed as an Art." The Controller. Vol. VII. Jan. 1939. pp. 12-19.
- Griffith, Donald K. "Weaknesses of Index Number Accounting." The Accounting Review. March 1937. pp. 123-32.
- Hansel, Philip H. "Analysis of Financial Statements." The Canadian Chartered Accountant. Volume XXXII. March 1938. pp. 177-187. Toronto, Canada.
- Mitchell, Walter, Jr. "Collection and Interpretation of Inventory Data." Journal of the American Statistical Association. Washington, D. C. June 1939.
- McFarland. "The Basic Theory of Standard Costs." The Accounting Review. June 1939. p. 151.
- Perkins, Lee. "Why Use Algebra?" The Journal of Accountancy. Vol. 74. pp. 242-245.
- Prytherch, Robert H. "How Much Test Checking is Enough." The Journal of Accountancy. Vol. 74. No. 6. Dec. 1942. pp. 525-530.
- Roren, C. Rufus. "Differential Costs." The Accounting Review. Dec. 1928. Vol. 3. No. 4. pp. 333-341.
- _____, "Similarities of Accounting and Statistical Method." The Accounting Review. Vol. 2. No. 1. March 1927.
- Scott, D. R. "Accounting Principles and Cost Accounting." The Journal of Accountancy. Feb. 1939. p. 70-72.
- _____, "Trends in the Technique and Tools of Management." The Accounting Review. June 1937. pp. 138-43.
- Theiss, Edwin L. "The Beginnings of Business Budgeting." The Accountant Review. March 1937. pp. 43-55.
- Wade, Harry H. "Statistics and the Accountant." Journal of accountancy. Vol. LI. Jan. 1931. pp. 34-43.
- Witty, Richard A. "Laundry Finance." Accountant. July 25, 1936. p.125.

Miscellaneous Reports

Annual Report. American Colortype Co. 1941.

A Report to the Employees of the Blaw-Knox Company. Blaw-Knox Company. 1938.

Annual Report. Borden's. 1942.

Annual Report. Cudahy Packing Company. 1942.

Annual Report. General Mills. 1943.

31st Annual Report. S. S. Kresge Company. 1942.

Annual Report. U. S. Steel Company. 1942.